WATCH "DINO DEATH TRAP" THIS MONTH ON NATIONAL GEOGRAPHIC CHANNEL

NATIONALGEOGRAPHIC.COM/MAGAZINE | DECEMBER 2007

NATIONAL GEOGRAPHIC



BIG BAD BIZARRE DINOSAURS

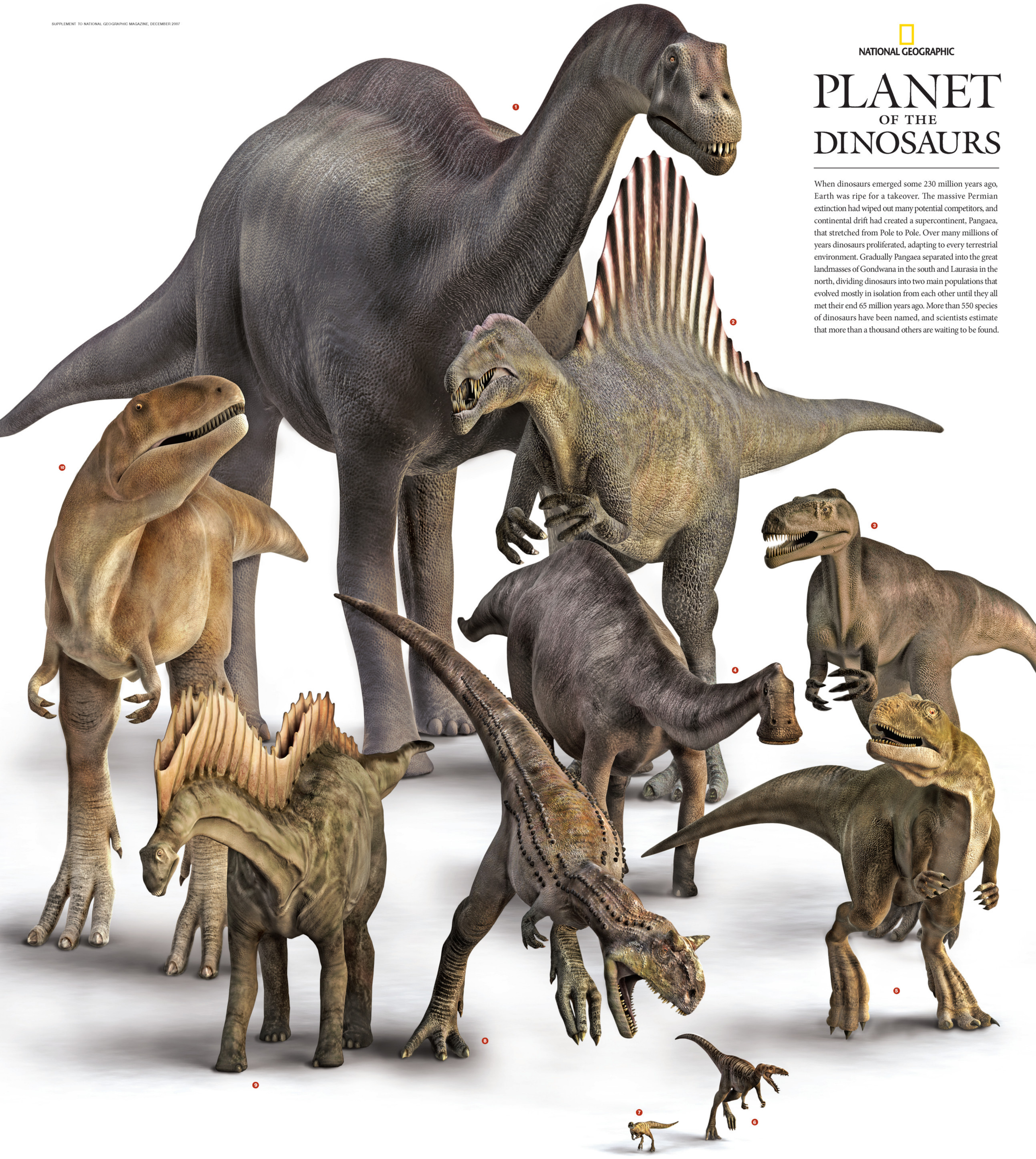
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SPECIAL SUPPLEMENT Planet of the Dinosaurs

NATIONAL GEOGRAPHIC

PLANET OF THE DINOSAURS

When dinosaurs emerged some 230 million years ago, Earth was ripe for a takeover. The massive Permian extinction had wiped out many potential competitors, and continental drift had created a supercontinent, Pangaea, that stretched from Pole to Pole. Over many millions of years dinosaurs proliferated, adapting to every terrestrial environment. Gradually Pangaea separated into the great landmasses of Gondwana in the south and Laurasia in the north, dividing dinosaurs into two main populations that evolved mostly in isolation from each other until they all met their end 65 million years ago. More than 550 species of dinosaurs have been named, and scientists estimate that more than a thousand others are waiting to be found.





The cluster of future continents within Gondwana started drifting apart 180 million years ago, during the middle of the Jurassic. Forty million years later, a seam running the length of the landmass began to broaden, giving rise to the South Atlantic (map, right). When the dinosaur era ended (far right), most of the modern pieces of the Southern Hemisphere had not yet reached their current positions, and India was still heading toward its collision with Asia.

GONDWANA

THE SOUTHERN HEMISPHERE

"Size matters" seems to be the theme of an evolutionary arms race that unfolded in the south. Plant-eating sauropods got bigger, leading to behemoths like *Paralititan* that were less vulnerable to smaller predators. Flesh-eating theropods gained size in turn: The monstrous likes of *Carcharodontosaurus* tackled the largest sauropods. The south is now the Wild West of paleontology, as scientists refine their understanding of its giants and the smaller dinosaurs that lived among them. Compared with the Northern Hemisphere, it's barely been touched.

1 *PARALITITAN* One of the largest land animals ever, the 90-foot-long titanosaur, dug up in Egypt, navigated shallow coastal channels, perhaps browsing the tops of mangroves.

2 *SPINOSAURUS* Arguably Earth's largest known land predator, it stalked coastal habitats in North Africa, hunting with croc-like teeth and claws capable of shredding big prey.

3 *AFROVENATOR* The teeth and claws of the "African hunter" resemble those of theropods in the Northern Hemisphere, offering clues about how early predatory dinosaurs dispersed.

4 *NIGERSAURUS* With a vacuum-cleaner-shaped mouth, filled with tiny teeth, it grazed along rivers that laced today's Sahara, perhaps using its long neck to reach water plants.

5 *MAJUNGASAURUS* Among the last dinosaurs to walk the Earth, this hunter dominated Madagascar. Evidence indicates it probably ate members of its own species.

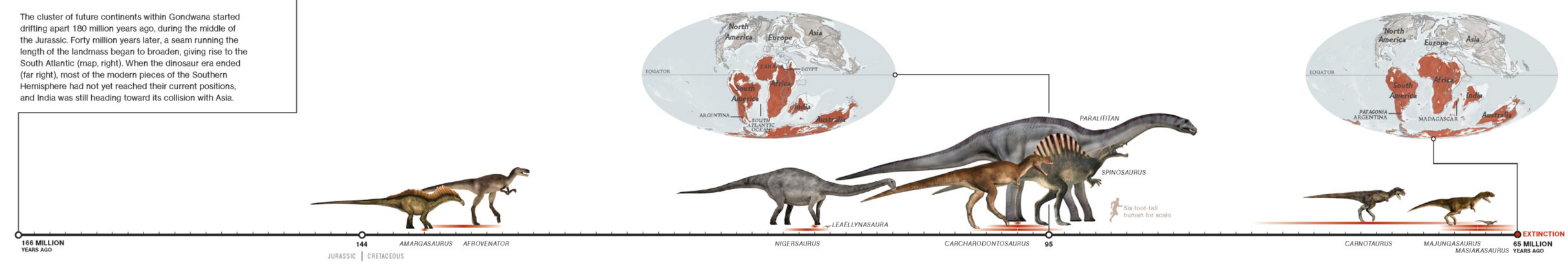
6 *MASIAKASAURUS* Quick and agile, it dodged larger Madagascan carnivores, such as *Majungasaurus*, while using its own curved, daggerlike teeth to stab smaller creatures.

7 *LEAELLYNASAURA* Found in Australia, which was then closer to the South Pole and dark much of the year, it had big optic lobes in its brain that hint at good night vision.

8 *CARNOTAURUS* Puny arms—tinier than *T. rex*'s forelimbs—contrast with the long legs and formidable jaws of this horned Patagonian carnivore, the "meat-eating bull."

9 *AMARGASAURUS* Dwarfed by its multi-ton cousins, this sauropod found in Argentina bore a double row of vertebral spines, which possibly supported sails of ligaments and skin.

10 *CARCHARODONTOSAURUS* A huge skull, shark-like teeth, and powerful legs made it a fast and deadly killer that possibly fed on large sauropods like *Paralititan*.



SUPPLEMENT TO NATIONAL GEOGRAPHIC MAGAZINE, DECEMBER 2007

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LAURASIA

THE NORTHERN HEMISPHERE

Ornamentation arose as a defining trend among northern dinosaurs, especially late in their reign. Titans such as *Mamenchisaurus* gave way to a profusion of smaller, faster herbivores with spikes, crests, and horns. Paleontologists say these features suggest advanced social behavior, since they often relate to attracting mates and recognizing members of the species. To hunt these smarter herbivores, theropods became more sophisticated, combining larger brains with brawn, eventually yielding the most famous dinosaur, *Tyrannosaurus rex*.

1 ***MAMENCHISAURUS*** Its 36-foot-long neck is the longest known of any dinosaur. The shape of the vertebrae indicates the Asian herbivore did not raise its head far above its shoulders.

2 ***TYRANNOSAURUS*** Scientists continue to study this dinosaur icon, first dug up in Wyoming in 1900. New analysis suggests it scavenged as well as hunted.

3 ***GIGANTORAPTOR*** This hulking beaked dinosaur stalked what is now China. It lacked teeth, and its diet is uncertain, but large claws would have made it an effective hunter.

4 ***PARASAUROLOPHUS*** The hollow bone atop its skull resembles an antler, but this duck-billed dinosaur, found in North America, probably used it to make trumpeting sounds.

5 ***ERKETU*** The Mongolian sauropod's neck extended some 25 feet, twice as long as its torso. The construction of its vertebrae signals that it browsed mainly near the ground.

6 ***VELOCIRAPTOR*** Discovered in the Gobi desert, this fleet, feathered theropod had a killer advantage: A sickle-shaped claw on each hind leg snapped forward like a switchblade.

7 ***SINOSAUROPTERYX*** The first evidence of dinosaurs with primitive feathers came with this 1996 discovery in China. A fossil found with a kill in its stomach confirms it as a carnivore.

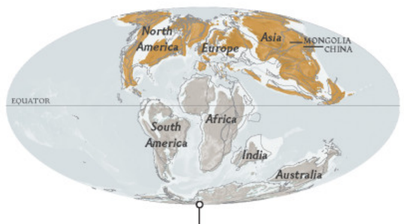
8 ***TUOJIANGOSAURUS*** Excavated in China, this stegosaur's bony back plates and shoulder spikes made the plant-eater look bigger than it was, perhaps deterring predators.

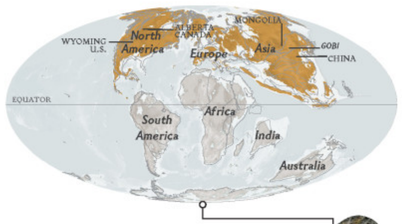
9 ***MONONYKUS*** Scientists speculate that this Mongolian theropod used its single-clawed forelimbs to dig insects out of underground burrows, similar to an anteater's technique.

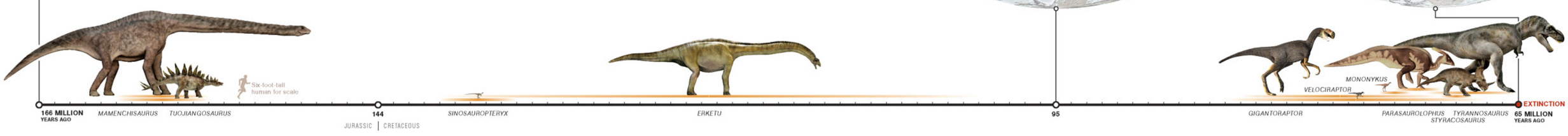
10 ***STYRACOSAURUS*** Found in Alberta, Canada, it probably traveled in herds. The nose horn could have fended off theropods, while its horned frill likely impressed mates.



Laurasia fragmented relatively quickly after its split from Gondwana, which some scientists believe accounts for the broad diversity of dinosaurs in the Northern Hemisphere. Once isolated from each other, dinosaur populations in what would become North America, Europe, and Asia pursued separate evolutionary paths, a process that occurred much later in Gondwana, which took longer to break up.







Think About It

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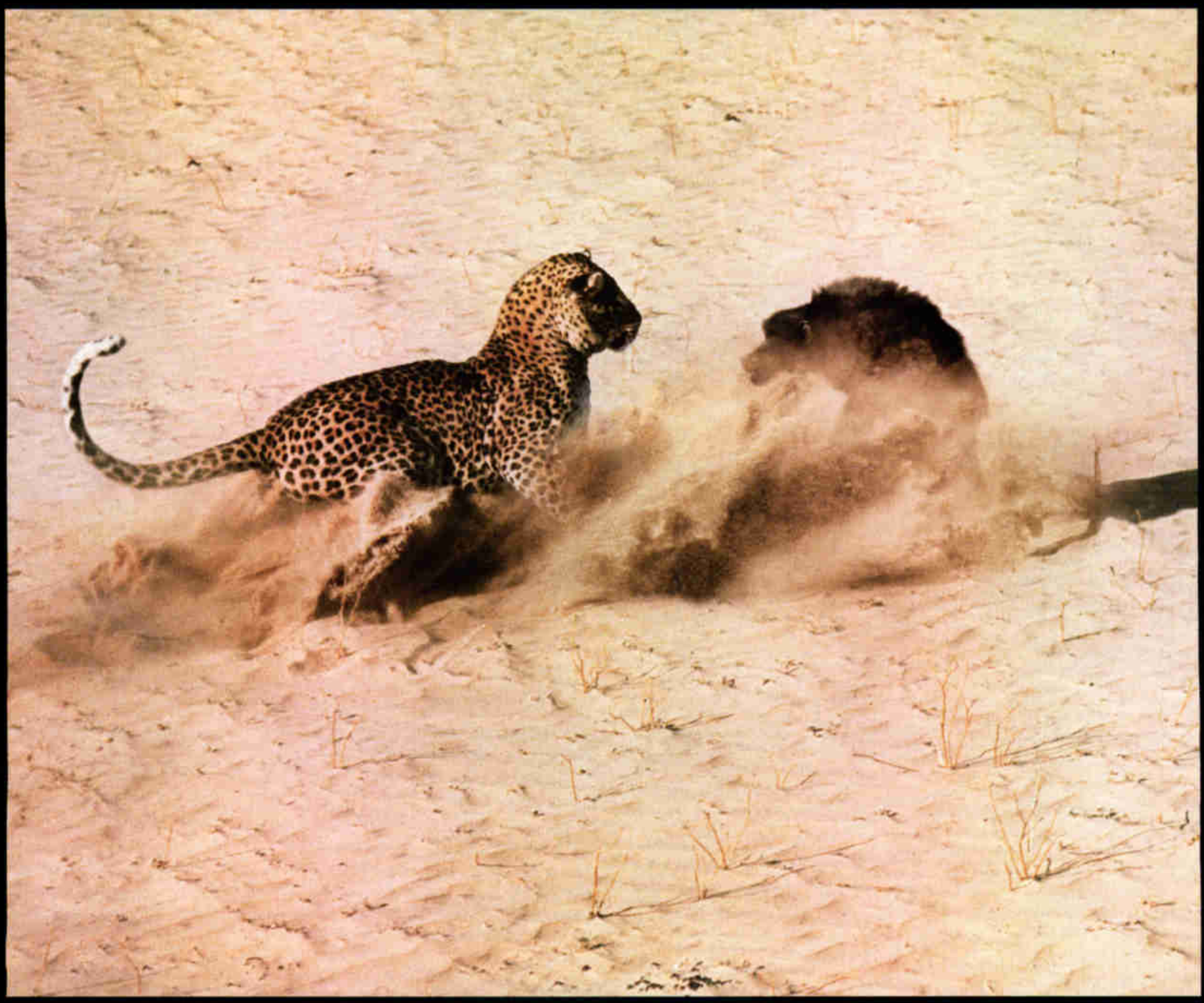
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> **CONTINUED at** *ThinkAboutIt.com*

*The 2007 Hyundai Entourage was a Winner in Strategic Vision's 2007 Total Quality Award™ as a 3-Way Tie for Best Minivan Experience. Strategic Vision's 2007 Vehicle Experience Study™ surveyed 27,780 Oct.– Nov. new vehicle buyers after the first 90 days of ownership. Hyundai is a registered trademark of Hyundai Motor America. All rights reserved. ©2007 Hyundai Motor America.

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Super Steady Shot inside



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If Carlos knows he is half Irish, one quarter Spanish, and one quarter Chinese, how is it possible that he is also 100% Tanzanian?*

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NATIONAL GEOGRAPHIC

DECEMBER 2007 • VOL. 212 • NO. 6

Near midnight on a cool spring night, Greek Orthodox worshippers circle Bethlehem's Church of the Nativity three times, singing hymns as they usher in Easter. Story on page 58.



CHRISTOPHER ANDERSON

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Extreme Dinosaurs 32
Fossil finds are revealing how evolution took some dinosaurs in bizarre directions, from domed skulls to sickle-shaped toenails.
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Bethlehem 2007 A.D. 58
The birthplace of Jesus is today one of the most contentious places on Earth. Israelis fear Bethlehem's radicalized residents, who seethe at the concrete wall that surrounds them.
BY MICHAEL FINKEL PHOTOGRAPHS BY CHRISTOPHER ANDERSON

Wings of the Albatross 86
Carried by the longest wingspans of any bird, they soar for thousands of miles without ever setting webbed foot on land.
BY CARL SAFINA PHOTOGRAPHS BY FRANS LANTING

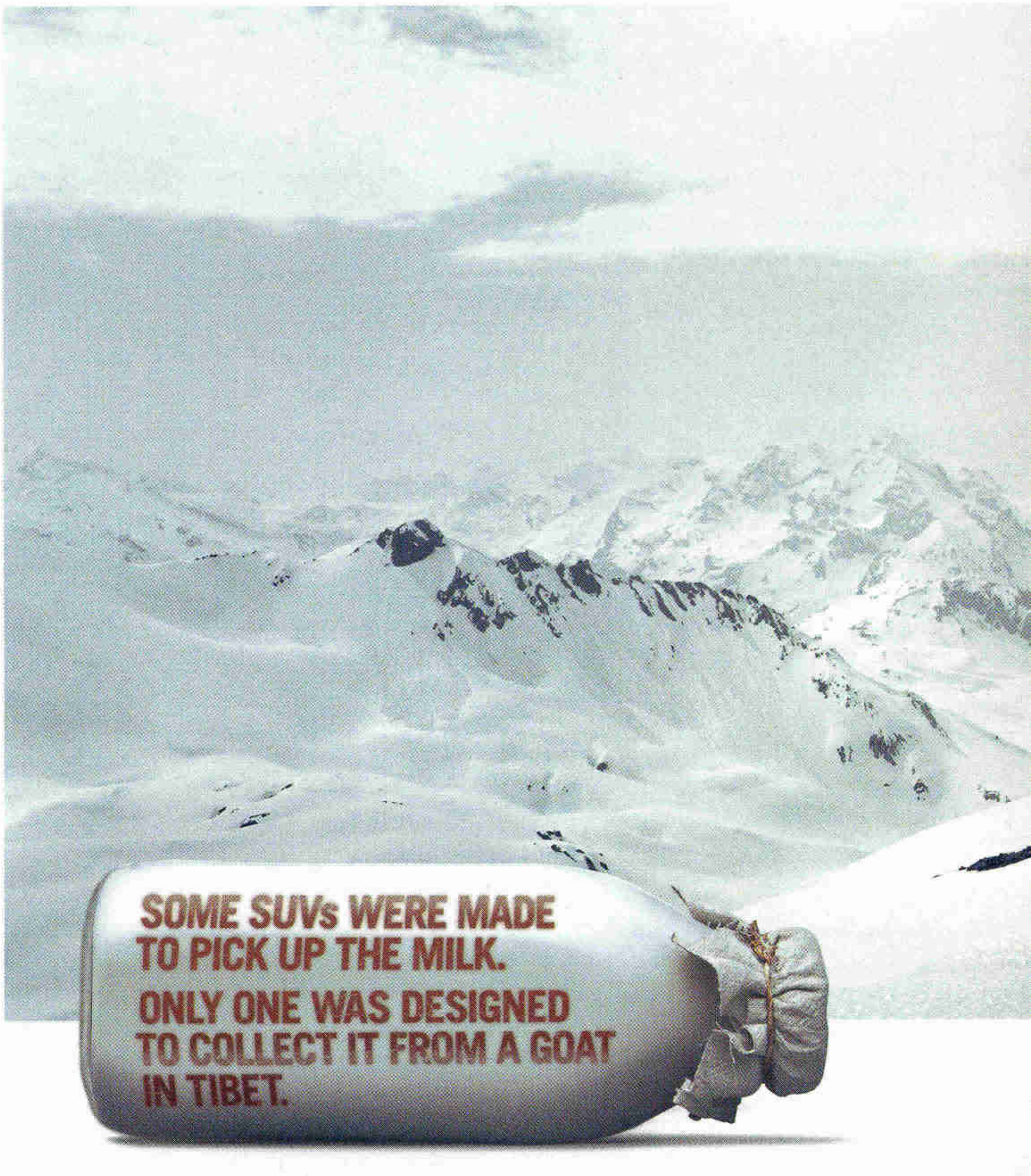
Enduring Cowboys 114
Conditions are tough, the pay is lousy, and there is no quittin' time. So why do cowboys love their job?
BY ROBERT DRAPER PHOTOGRAPHS BY ROBB KENDRICK

Frozen Ground 136
Vast reaches of the planet have been locked for millennia in stunning permafrost formations. But perhaps not permanently.
ESSAY BY BARRY LOPEZ PHOTOGRAPHS BY BERNHARD EDMAIER

COVER A skull full of spikes and knobs earned this plant-eating dinosaur the name *Dracorex,* or "dragon king." **ART BY DAMNFX**

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FLASHBACK

On the Web

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Dinosaurs: Then and Now
A leading paleontologist uses historic National Geographic artwork to offer insights into our understanding of dinosaurs.

Interactive Albatross
Learn about the evolutionary magic that keeps these birds aloft for such great distances.

Keeping Up With the Climate
The latest reports from *Climate Connections,* a continuing collaboration between National Geographic and NPR, are posted at *ngm.com/climateconnections* and *npr.org/climateconnections.*

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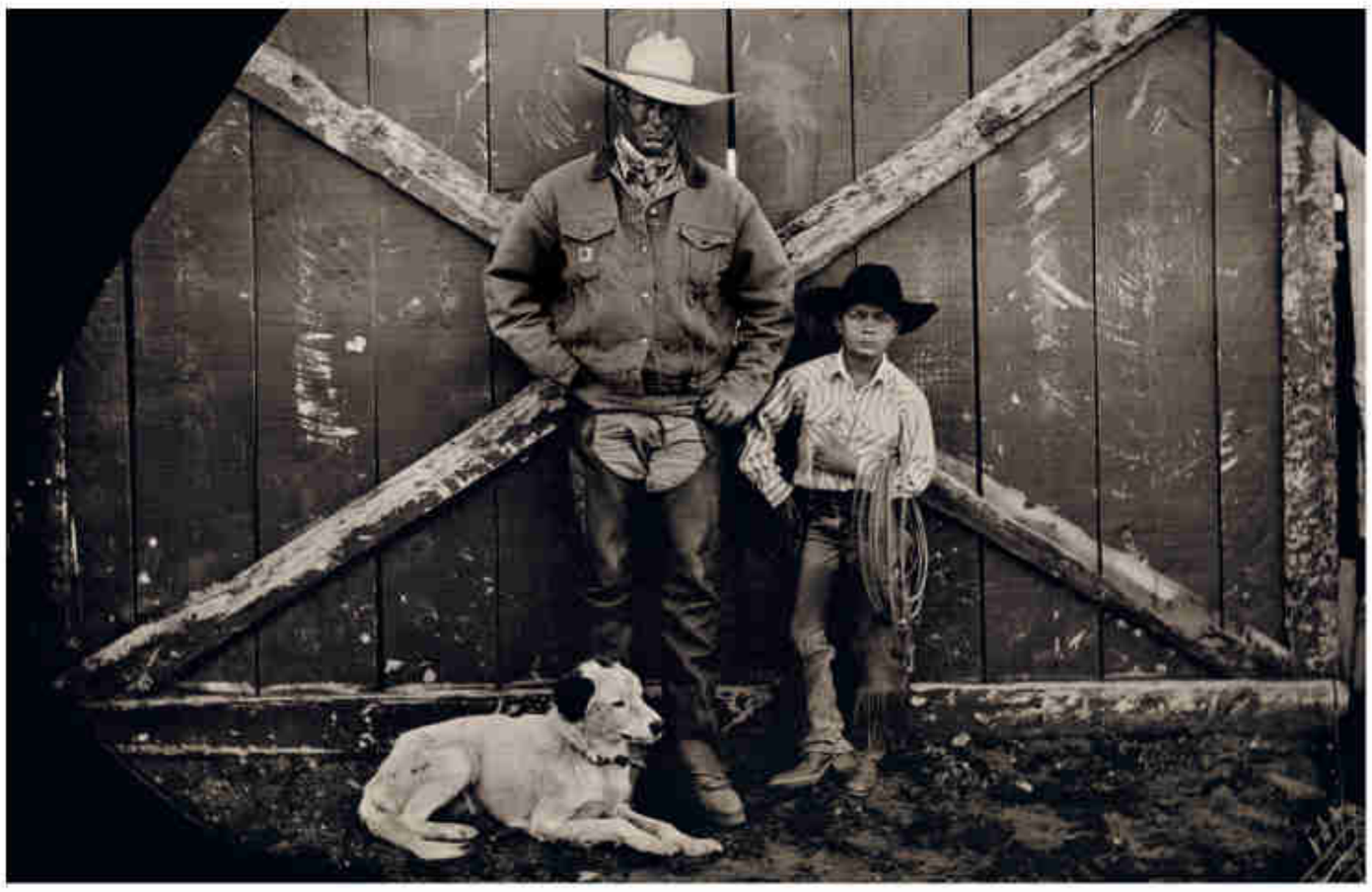


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EDITOR'S NOTE



Cleve Anseth and son wear the hats of the Oregon cowboy.

I'm leaning against the wall of a seedy tavern in Williams Lake, British Columbia—a buckaroo town if ever there was one—waiting for two brothers to take me fishing, when a young cowboy ambles up. We're dressed alike: cowboy hat, boots, Western shirt, Wrangler jeans, and a big, shiny belt buckle. "You're from NATIONAL GEOGRAPHIC, ain't ya?" he says.

"Why are you asking?" I respond with surprise.

"Because you're wearing an out-of-town hat."

Slightly embarrassed, I survey the bar's clientele and realize he's right. I'm wearing a beat-up, black Stetson I'd bought years ago in Pendleton, Oregon. It's the only one of its kind in the room.

The young man told me that when new ranch hands show up at work, locals check out their hat, boots, chaps, rope, saddle, bridle and bit, and can tell where they're from. Their gear is a give-away; it's made to function in the terrain where they work.

"If it's not functionable, it's not worth wearing," says Colter Schlosser, a cowboy from British Columbia. But function and fashion are not necessarily mutually exclusive. Look at the photo of Schlosser on page 115, and you'll see what I mean. This month, Robert Draper and Robb Kendrick decode the elegant appearance of a Canadian buckaroo and the no-frills look of his Texas counterpart. Cowboys and their gear are hardly stuck in the past. Everything evolves in response to the demands of economics and the push of technology. Computer-based ear-tagging aside, some things never change—like the telltale shape of a hat.

Just ask a buckaroo from Williams Lake.



PHOTO: ROBB KENDRICK

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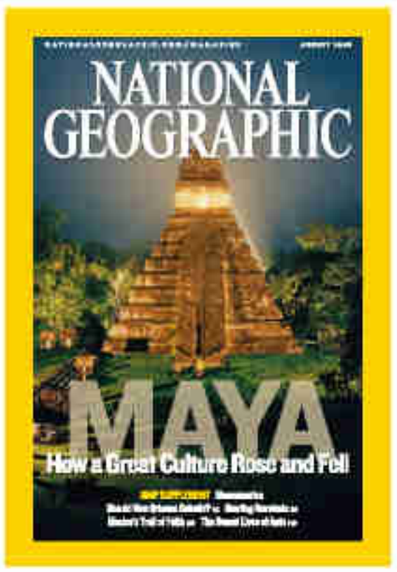


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LETTERS



August 2007 *Our story "Should New Orleans Rebuild?" drew the most mail this month. John Chellino of Miami, Florida, wrote, "A better question would be, what is the best and smartest way to rebuild New Orleans? Americans of many stripes care viscerally about that city. We know about its problems, but we also know it matters because it's homeland."*

Comment on December stories at **ngm.com.**

New Orleans

It would be ludicrous for New Orleans to rebuild in the same location. After reading your story, I was appalled to learn that the city has been devastated no fewer than 27 times. Anyone asinine enough to rebuild on a site that already lies below sea level, continues to sink, and has such a recurrent history of disaster should be cut off from any federal aid when it happens again. And it will happen again.

DON CRAWLEY
Littleton, Colorado

Y'all ask if New Orleans should rebuild. Well, why should we not? How many times has Florida been hit by a hurricane? New Orleans is not just the home of people, but also the home of jazz, Creole food, and a spirit that cannot be felt anywhere else. Losing New Orleans would mean losing not just a city, but a place where millions of memories were made. How would you feel if your city was taken away? And if New Orleans is not rebuilt, should we not rebuild California the next time it has a mud slide or earthquake? Or the next time Oklahomans have a tornado, should we not help them get back on their feet? We cannot live in fear of what's going to happen in the next 150 years!

LAUREN DE BAUTTE
Slidell, Louisiana

Three things entered my thoughts while reading the compelling article on New Orleans. First, it was nice to see the author focus on the real reasons for the disaster instead of the usual political bashing of the Bush Administration. This is a problem that has been brewing for 289 years and has plenty of blame to go around. Second, the waste and fraud in the flood-protection work is just criminal. Every agency seems to have some culpability, and it's beyond me why we have heard of no criminal investigations. Third, the map on page 61 shows the whole problem. There is no way a city of any size should be built on that peninsula. If Torbjörn Törnqvist [a Dutch coastal geologist at Tulane University who envisions a flood-protection system for New Orleans] needs to learn how to make a city survive these conditions, let him do it with the Netherlands' money!

CURTIS FRY
Citrus Heights, California

Rebuilding New Orleans would be like restoring Spirit Lake by shoveling all the debris from Mount St. Helens back into the crater. It will only end up back where it was intended to be. The sad part is that taxpayer money is being used to do this. Decades from now when New Orleans is underwater, we will look back at the billions of dollars spent and wonder what the politicians were thinking.

CHUCK COLEMAN
Portland, Oregon

"Floods are 'acts of God,' but flood losses are largely acts of man." This quote is still so valid across the globe. During the catastrophic flood that hit Poland in 1997, many losses occurred only because over the last half of the century, people settled on lower ground that was supposed to stay free. We have learned how to fly to space, but at the same time we have lost our minds and begun to build houses where our grandfathers would not even risk setting up a tent.

TOMASZ GINAL
Nadarzyn, Poland

When are the inhabitants of this planet going to figure out that water always has the last word?

MERILYN TROCINO
Vancouver, Washington

Write, Email, Fax

Write
National Geographic Magazine
PO Box 98199
Washington, DC 20090-8199

Email
ngsforum@nationalgeographic.com

Fax
202-828-5460
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Whoever said you have to wait for your refrigerator to break to get an LG?



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LETTERS

I read with much interest your article on the devastating effects of Hurricanes Rita and Katrina on New Orleans, and how much land, through water saturation, you have lost. This summer in Great Britain we have suffered much water saturation through heavy rainfall, but not on a par with your situation. Our people were without power and drinking water, and in some cases had no homes. Unfortunately, aid seems to be little, and bearing in mind the size of our country and the cost of housing, there is very little room for people to move, as some of your people in New Orleans did. Our problem is that our drainage system is so old and needs replacement, but our central government doesn't bother. We have inadequate water defenses with our rivers, and many of our homes are built on low-lying floodplains. Developers know the consequences of the weather (though this might not happen again for 40 to 50 years), but our government is still insisting on building more homes on existing floodplain areas.

SUE VORE
Brighton, England

Regarding New Orleans:
I applaud the loyalty and self-reliance of the residents in attempting to resurrect the city. However, I object to potentially having to support the recovery from another disaster with tax dollars, when it seems so likely to happen. If people want to live there, it should be at their own risk.

RICHARD PERINI
Holland, New York

It is true that New Orleans has problems with flooding, but it is a port city. Very few port cities can be located in dry places.

PAUL LACOSTE
Metairie, Louisiana

Residences and decision-making alike must move to higher ground regarding the future of New Orleans. Cool pragmatism must prevail over emotional attachment to place. Those who expect a return to pre-Katrina New Orleans life are selfishly myopic. Not only were residents' lives devastated by the tragedy, but emotional and other costs were also borne by families, friends, and fellow citizens throughout the country. Rescue workers put their lives and health in harm's way. Taxpayers bore the costs of the devastation and will be required to do so once again, inevitably. To rebuild the residential life of New Orleans is nothing less than reckless endangerment.

CAMERON OTOPALIK
Ellensburg, Washington

When people are building houses in New Orleans on properties that lie as much as 17 feet below sea level, they are waiting on calamity to come along. Why are we then surprised when it happens?

ROGER BARTLEY
Richmond, Kentucky

Corrections, Clarifications

August 2007:
Photo Journal The photo on page 12 was made at Colorado's Buckley Air Force Base.
Harry Potter's Garden The forerunners of aspirin were made from willow bark, not willow leaves.

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LETTERS

The Maya: Glory and Ruin

Thank you to Simon Norfolk for his wonderfully illuminated photos of the Maya temples. The Inside Geographic description of his work noted that the Geographic's lighting generators were left behind at the sites where previously no significant sources of electricity were available. His photo of Palenque brought back an amusing memory of my 1975 visit there. It was an early, misty morning, and two of us were the only visitors. As we entered the hushed grounds, a clear and loud recording of Elvis Presley's "Heartbreak Hotel" broke the silence. Dissonance would be the best word to describe that experience. Apparently someone nearby—perhaps a groundskeeper—had sufficient electricity to expose the spirit of Pakal to Elvis.

SHARON LIEBERMAN
Evanston, Illinois

As I read about the stresses that pushed the Classic Maya civilization into decline and collapse, "overpopulation, environmental damage, drought, and extravagance," I immediately realized how frighteningly similar those circumstances are to present-day life here in this country.

RODNEY RUTH
Allendale, New Jersey

The article carried me pleasantly back in time to my college days when I took a course in Maya civilization at the University of Texas at San Antonio. In the 20 years since, so much new information has surfaced. I was amazed at the advancement the archaeological excavations and research have made in revealing more of the mysteries behind the Maya city-states. What a wonderful revelation it would be if Mexico and Central America would see history repeating itself in the rise of another empire during the 21st century as great as the empire the Maya built.

JOANNE CLAYTON
Caseyville, Illinois

If they are willing to embrace modern weapons in their traditions, perhaps they can also embrace the modern realities that make their treatment of narwhals both unsustainable and inhumane.

Arctic Ivory

The picture of the Inuit hunters with rifles raised [pages 116-17] creates for me a chilling tableau of human cruelty toward animals. Their actions become more troubling in light of the fact that only a fraction of the whales are ever recovered after being killed or wounded. Regardless of one's opinion on hunting, this seems like such a waste of life. Just as I respect every animal's right to live free from harm, I respect the right of the Inuit to preserve their traditions, identity, and livelihood as a culture. But if they are willing to embrace modern weapons in their traditions, perhaps they can also embrace the modern realities that make their treatment of narwhals both unsustainable and inhumane.

JUSTIN VAN KLEECK
Troy, Virginia

The article about Inuit hunting narwhals in the Canadian Arctic drew attention to the problem of "struck and lost" whales, a term used to describe animals wounded but not landed. Many of these unfortunate animals will suffer long and lingering deaths as a result of the wounds inflicted on them; the phenomenon of struck and lost is to the disadvantage of both whaler and whale. It is clear that even with significant modernizations in weaponry, i.e., the use of rifles as opposed to traditional harpoons, there is simply no humane way to kill a whale at sea.

CLAIRE BASS
London, England

As an avid hunter, I have suffered the same anxieties as the Inuit when they have lost their quarry. Our hunting ethics dictate and in some cases legally obligate us to exhaust all avenues to retrieve the game that we have harvested. Losing game is a waste of our natural resources and is a source of tremendous guilt. However, as a hunter and a certified diver it occurred to me that the Inuit could pool their resources into a co-op and purchase cold-water diving gear that could be used to retrieve the dead narwhals. The cost of one or two retrieved narwhals should cover the costs of the diving gear and certification.

BART FRANKLIN
Austin, Texas

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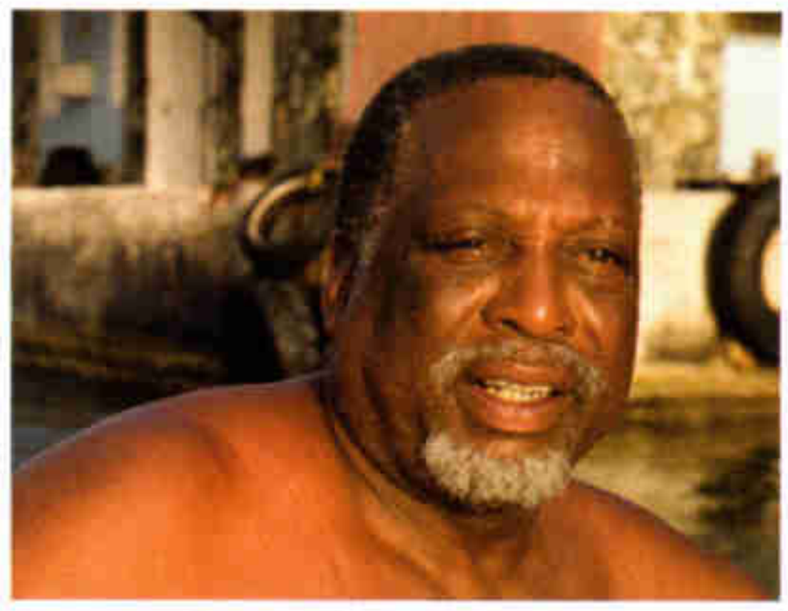
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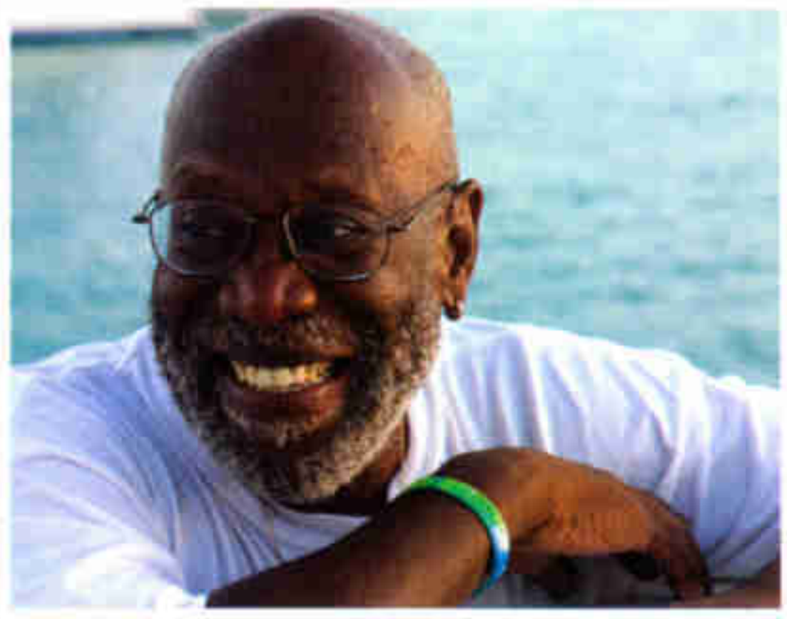
Meet Captain William Pinkney and Captain Paul Mixon, two men who have used sailing to spread learning and joy, as well as to achieve their wildest dreams.

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Dream Making

➤ It took only one day on the San Francisco Bay to get Paul Mixon (above top) hooked on sailing. That was 30 years ago. Today Mixon, 65, shares his sailing dreams with others through the Black Boaters Summit, which he created to introduce African-Americans to the sport. African-Americans have long been a minority within the sailing community. Mixon never expected he could one day organize a flotilla of African-Americans who would join him sailing the British Virgin Islands.

Mixon's good friend, Captain Bill Pinkney, 71, (above bottom), a master sailor and adventurer, had his own sailing dreams. Remembering *Call It Courage*, the classic adventure tale he read when he was just in grade school, Pinkney made his boyhood hopes a reality when he started planning a remarkable solo voyage around the world. It was the ultimate inspirational legacy he wanted to leave his grandchildren.

Plan Together

➤ Pinkney's voyage was followed by hundreds of schoolchildren via computer and satellite radio and television. "Bill is the real deal," says Mixon. "Not only did he circumnavigate the globe alone, but he chose the most difficult passages in the world." Pinkney traveled the southern route around the five great capes, including Cape Horn's infamously treacherous waters. He was the first African-American to sail around the world alone via this route.

Of the trip, Pinkney says "it was something that said a lot, not just about myself, but said a lot about the human experience." His story was published in a book for first-grade children, *Captain Bill Pinkney's Journey*, which still elicits many letters from children who tell him they want to make a commitment in their life—and follow through on it.

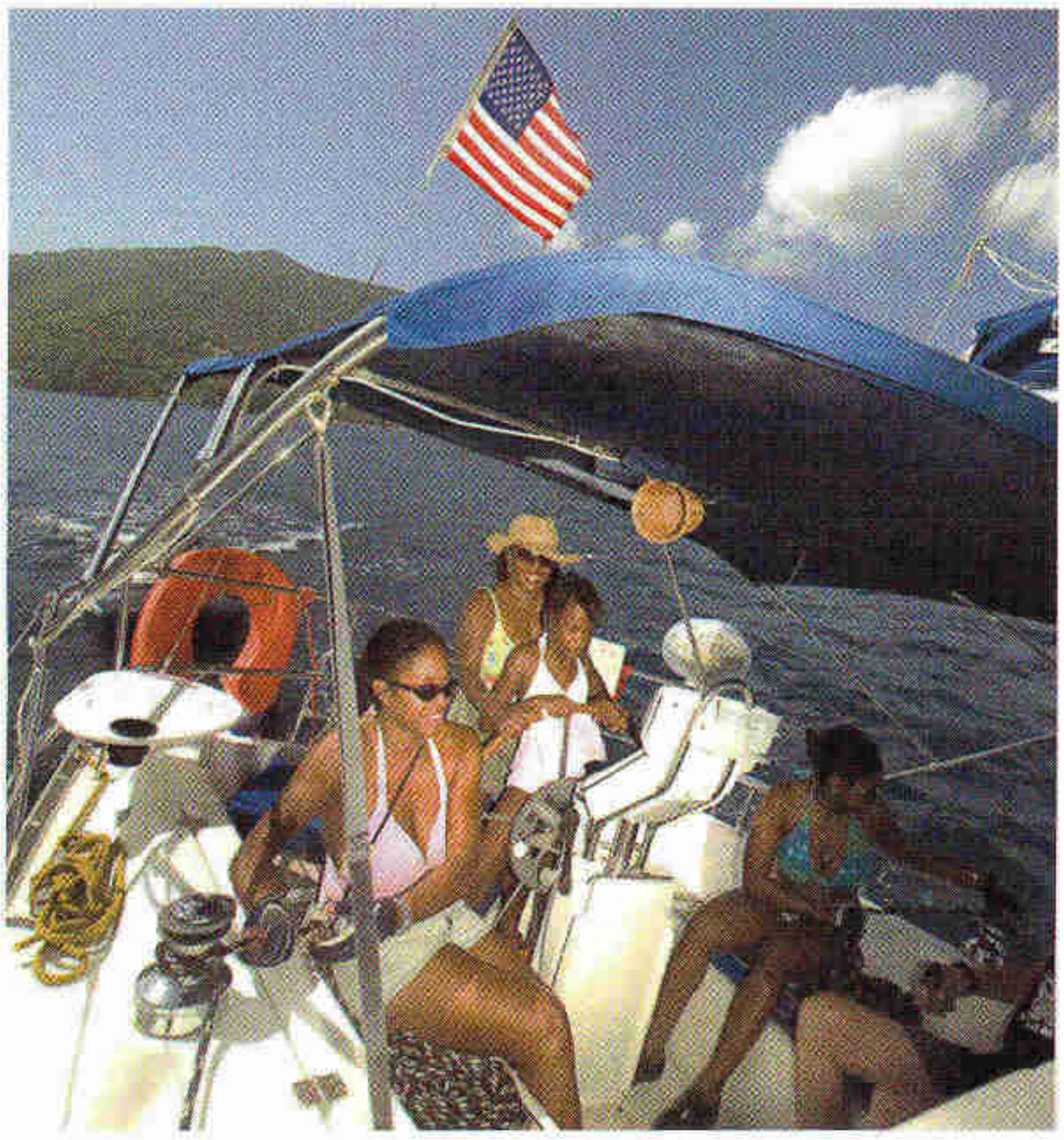
After being introduced by a mutual friend years ago, Mixon and Pinkney planned how they could work



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together to attract African-Americans to the sailing community. Mixon used his entrepreneurial skills to organize the business, and Pinkney used his reputation as a master sailor and a positive role model to draw people to the trips. Together with the Black Boaters Summit they have sailed the British Virgin Islands and shared their love of sailing with a new generation of African-Americans. "It was an uphill battle to try to convince people to get out on the water with nothing more than a sail and a rope," says Mixon. In fact, according to Mixon, many of the participating sailors cannot even swim and had no previous exposure to open water. "At the end of the day it's very rewarding to see the smiles on the faces of our first-timers," he adds.

Track the Journey

➤ The Summit, an annual summer event, which initially tested the waters with only ten participants, is now in its tenth year and has attracted as many as 280 sailors on 24 boats. All of the boats' captains are African-American men and women who have made sailing their sport. It's evolved into a network that has created many friendships and six marriages. Although the project has mostly been a labor of love, Mixon would love to find a co-entrepreneur to build his business while he plans his next adventure. "I'm looking for someone who can take what I've done over the past ten years and take it to the next level," says Mixon.

Pinkney's latest venture is the Amistad Freedom Tour, an educational project which retraces the famous voyage of *La Amistad,* a symbol in history's movement to abolish slavery. The new *Amistad* serves as a floating classroom during its 16-month, 14,000-mile journey from Connecticut to Great Britain, Lisbon, West Africa, and the Caribbean. Pinkney serves as first master and spokesman for the project.

Says Pinkney, "You can't make fantasies happen, but you can make your dreams come true… Persistence, diligence…it's going to take water in some kind of way: salt water, sweat, or tears—but you'll make it. That's what I'm most proud of…I turned a dream into a reality—not just for me, but for a lot of young people as well."

To learn more about how Paul Mixon and William Pinkney share their passion for sailing with others, visit ***nationalgeographic.com/LifeDreams.***









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LETTERS

Mexico's Pilgrim Cowboys

Alexandra Fuller's journey on Mexico's Trail of Faith is a miracle itself! I lived in Mexico several years and witnessed firsthand the devout faith of the Mexicans. In this time of conflict between religions and within religions, the closing dialogue in Fuller's article aptly illustrates what many hope is an underlying and unifying focus of such pilgrimages of peace whether in Guanajuato, Mecca, Jerusalem, or Benares.

KURT DESOTO
Fairfax, Virginia

I was appalled at the treatment of the horses in "Mexico's Pilgrim Cowboys." The religious purpose for which they ride is no excuse for the brutality they subject their horses to. The description of the tied horse with colic (an incredibly painful condition), the starving dam whose foal died, the many horses tied or crowded so they could not lie down to rest—how can these "cowboys" believe this is the path to God? It is not "pampering," as the article states, to provide a horse with basic food and a blanket. I grew up with real cowboys on real ranches, and the people portrayed in this piece are about the furthest thing from a cowboy that I could imagine. I would have respect for them if they walked, but this is a pilgrimage made possible only by the suffering of the horses and should be condemned as such.

KATHLEEN CULBERTSON
Moorpark, California

Ants: Able Bodies

When I read the story about the ants, I was astonished at how intelligent they really are. I became full of regret for every little ant I ever stepped on in my childhood. They make and use "doors"! Is that not evidence enough of the mysteries and beauty of other living creatures? Intelligence truly is relative, and for that I hope all people rethink how they treat ants and all animals.

LAUREN TARTAGLIA
New York, New York

The use of plastic and paper bags should simply be forbidden or, at least, these unnecessary things should be made prohibitively expensive.

Science: Harry Potter's Garden

I don't feel you were complete in the description of the yew, arguably the most toxic plant known in the Northern Hemisphere. Yews, or plant species that fall under the genus *Taxus,* contain a compound called taxine, which is severely cardiotoxic. I personally witnessed a large herd of cattle succumb to this deadly toxin. Eighty percent of the herd died within an hour of the first ingestion, and the remaining individuals survived only because we were able to intervene.

GEOFFREY G. ADAMS, D.V.M.
New Port Richey, Florida

Geography: Who Gives Parents a Break?

NATIONAL GEOGRAPHIC can chastise the U.S. for being behind the rest of the world in forcing private employers to be an extension of the welfare state. I don't see that as a problem. I'm more concerned that the rest of the world is so far behind the United States in providing economic liberty—and the resultant economic opportunities—to its people.

BRANDON CROCKER
San Diego, California

The issue of guaranteed leave for mothers is not as simple as you would like us to think. There is no mention of who pays for the paid time off, what that forced cost to employers does to new job creation, or other cost-benefit factors. By the way, from what I have seen in my six trips to Cuba, that touted Cuban mother probably uses her "paid" leave to bond while in the ration line.

LINDA RAWLES
Mesa, Arizona

Environment: Litterbag

In the Netherlands, where I was born and raised, grocery stores charge a quarter (perhaps more nowadays) per plastic bag, creating an incentive for using reusables. Not only are cloth bags better for the environment, they are usually also nicer to look at and hold much more without tearing. The use of plastic and paper bags should simply be forbidden or, at least, these unnecessary things should be made prohibitively expensive.

MICHEL H. E. HERMANS
Newtown, Pennsylvania

*Estimated savings compares each U.S. HSD vehicle's EPA combined mpg rating with its segment average based on latest EPA Trends Report (driven 15k miles/yr). Actual mileage will vary. ©2007

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Bug Snappers The Your Shot editors were entranced by things on the wing this month. What's bugging you? Grab your digital camera, take a picture, and send it to us—the photo could end up on the Your Shot website as one of our Daily Dozen selections. You might even see it in the pages of NATIONAL GEOGRAPHIC. For guidelines, a submission form, and more information, go to *ngm.com/yourshot*.



Renee Rorrer Winston-Salem, North Carolina

"His face had so much character," says Renee Rorrer, 38, of the luna moth that called her front porch home for a couple of days. "He was such a calm model. I made a perch from colored paper so I could move him around without handling him."



Jamie Lynn Burton Snowville, Virginia

The morning glory vines invading the family farm annoyed everybody but Jamie Lynn Burton, 31. Her photo of a bumblebee invading one of the pesky vine's flowers, she told relatives, was "the one that was going to get me into NATIONAL GEOGRAPHIC." She was right.

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Marcin Kłysewicz Sturminster Newton, England

"I grew up in a little village in Poland," says Marcin Kłysewicz, 29, who moved to England a year ago. "I was always sensitive to nature." He still is, spending early mornings along the local riverbanks photographing creatures like this dew-laden damselfly.



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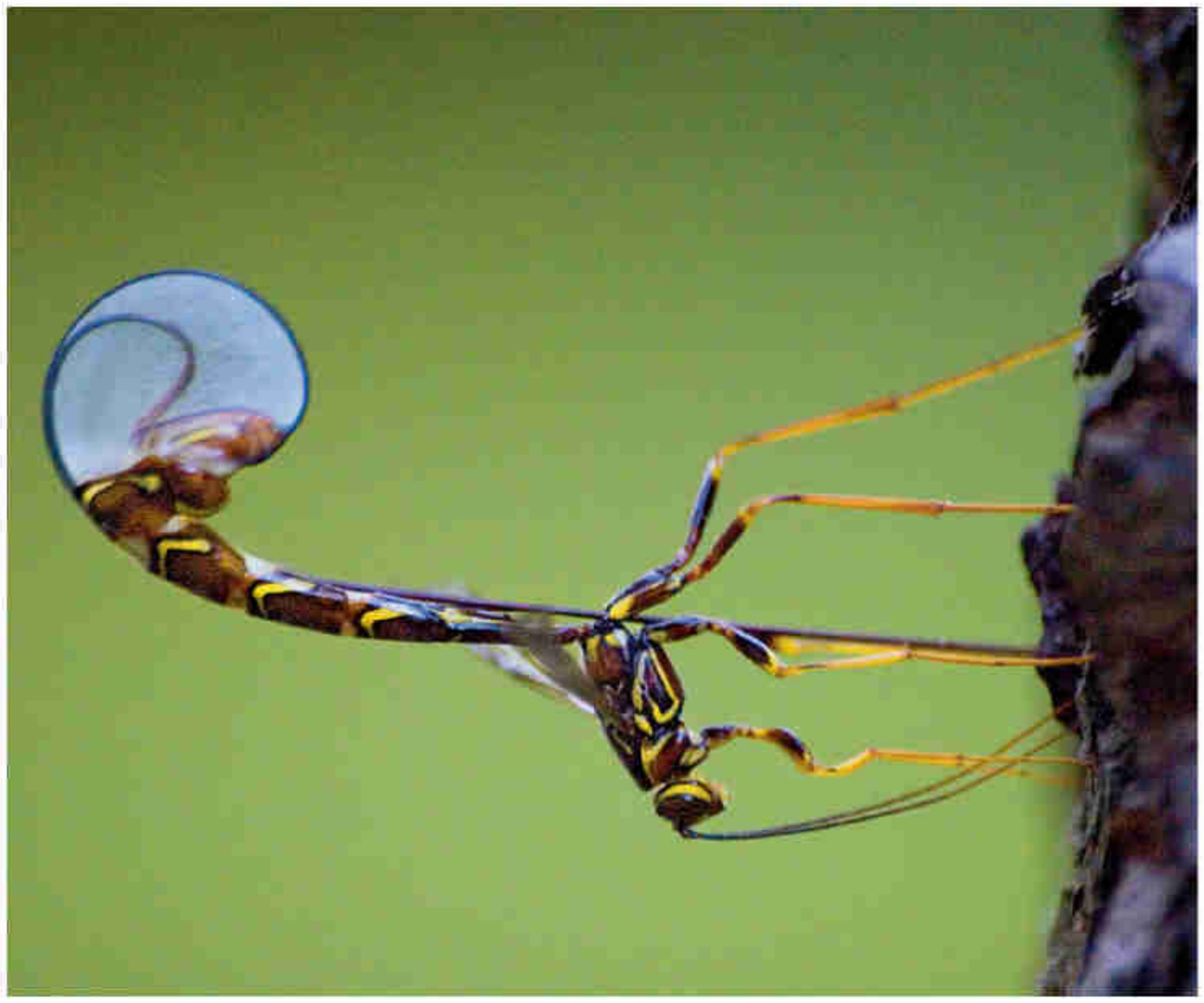
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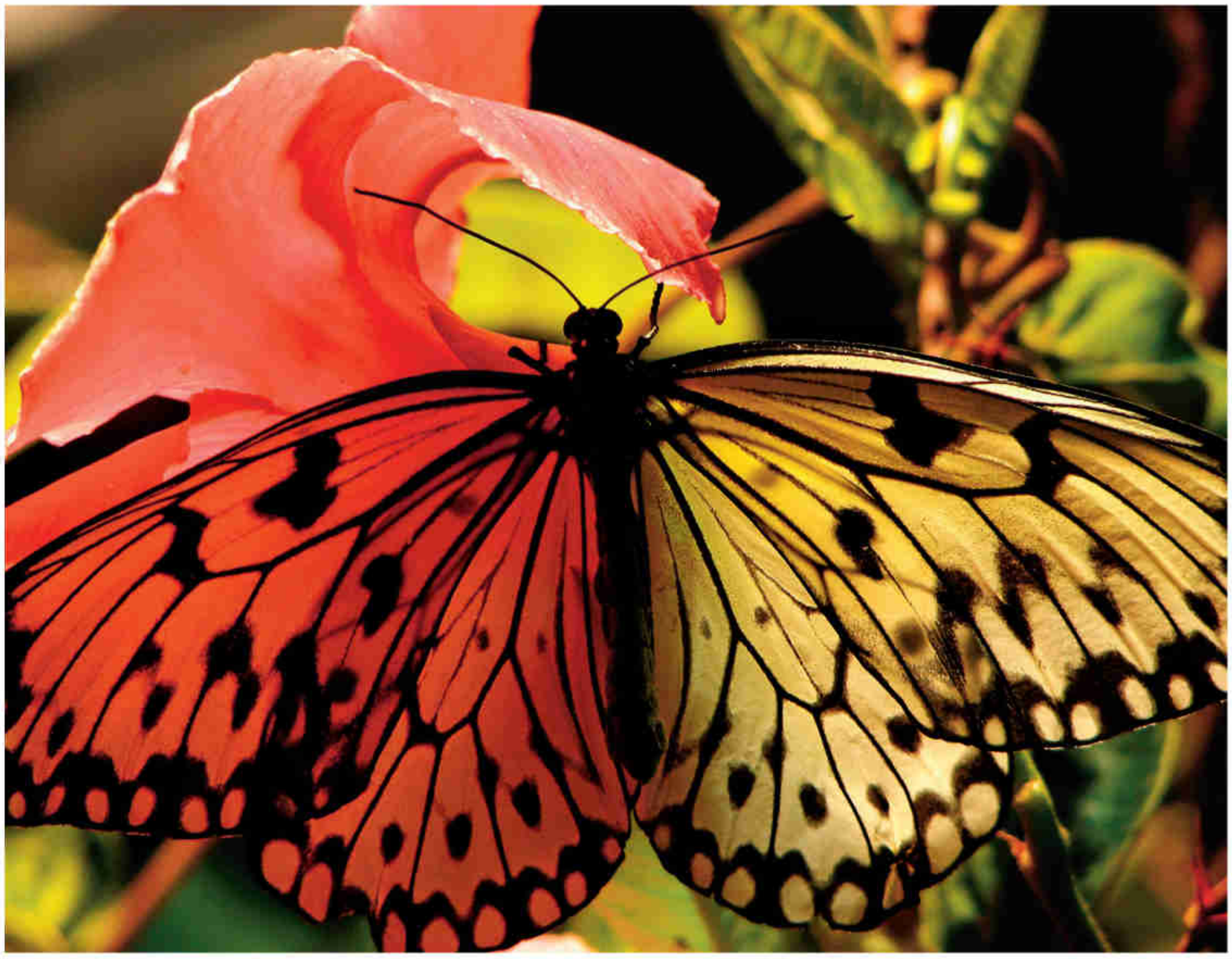


David Musso
Streamwood, Illinois

"I got as close as I could without disturbing her to take the picture," says David Musso, 27, who nevertheless found the sight of this enormous ichneumon wasp laying her eggs "extremely intimidating."

Sara A. Vera Beltrán
Angol, Chile

When the butterfly Sara A. Vera Beltrán, 30, shot at an exhibition in New York City stopped on a flower, she says, "its translucent wings made it look like a ballerina in a bicolor tutu. Nature can be simple and magnificent at once."





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The face of the world is changing. Global warming is heating up the planet and altering nature's delicate balance. Extraordinary heat waves are becoming more common, exacerbating the recent drought in America's Southwest and increasing the frequency of wildfires as far north as Canada. Many European plants now flower up to a week earlier; some alpine plants, nonmigratory butterflies, and North American foxes have moved north to cooler climates. Rising temperatures have also increased the virility and range of mosquitoes, with one species now thriving at twice its normal altitude.

These are the changes to which all living things must adapt - ourselves in particular. Through a greater understanding of how humans contribute to global warming, we are learning new ways to limit the impact of climate change and preserve our planet. To expand your knowledge visit **www.nationalgeographic.com.**

The face of the world is indeed changing, but through knowledge we can change our ways.

Changing Knowledge: GLOBAL WARMING



The more dangerous thing on the planet is

a) a pack of wolves
b) a herd of cows

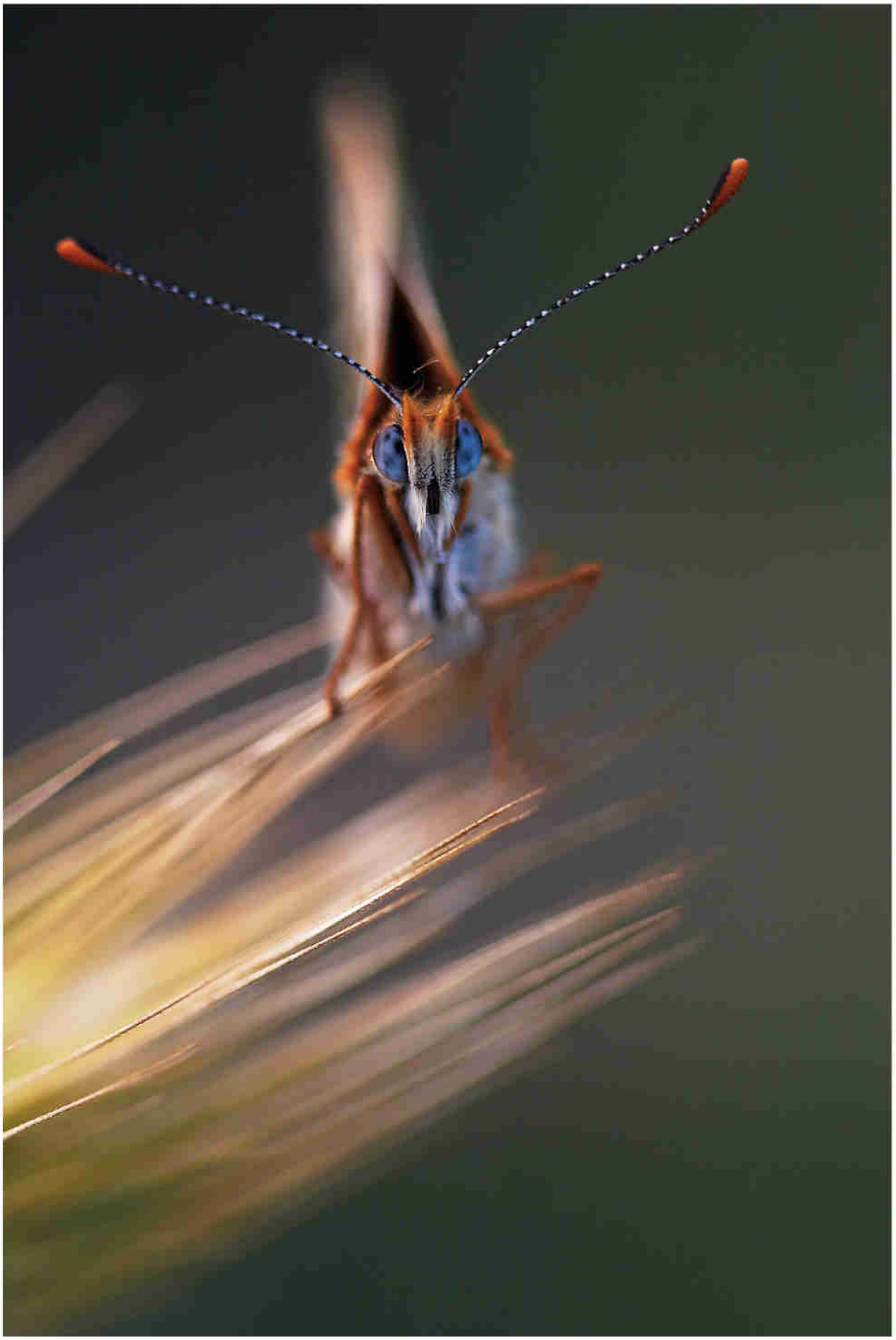
Livestock is one of the largest sources of the world's greenhouse gases. Having global expertise in Risk Management, our experts at Allianz are working on ways to reduce the negative effects of climate change on people and businesses. Together with our global partners, we encourage dialogue and the sharing of knowledge on these crucial issues. After all, it's knowledge that makes the change.

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Serge Tollari Montpellier, France

Soon after sunset one April evening, in a wetland in the south of France, Serge Tollari—a 36-year-old professional photographer—captured this image of a fritillary butterfly in, he says, "a crepuscular light."

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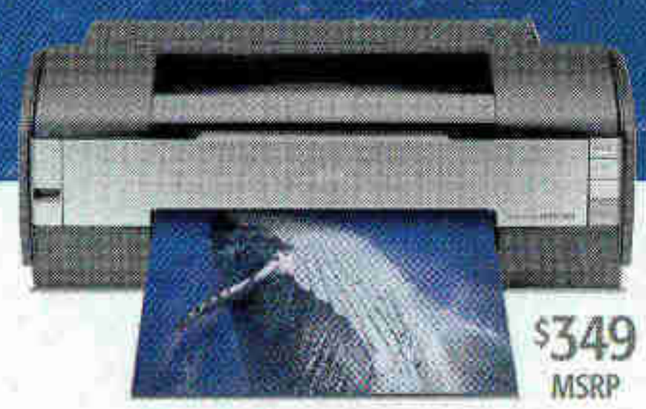
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*Requires Bluetooth®-compatible cellular phone. **The Rear Sonar System is a convenience but is not a substitute for proper backing procedures. Always turn and check that it is safe to do so before backing up. Rear Sonar may not detect every object behind you. †Savings based on MSRP. Dealer sets actual price. Nissan, the Nissan Brand Symbol, "SHIFT_" tagline and Nissan model names are Nissan trademarks. Always wear your seat belt, and please don't drink and drive. ©2007 Nissan North America, Inc.

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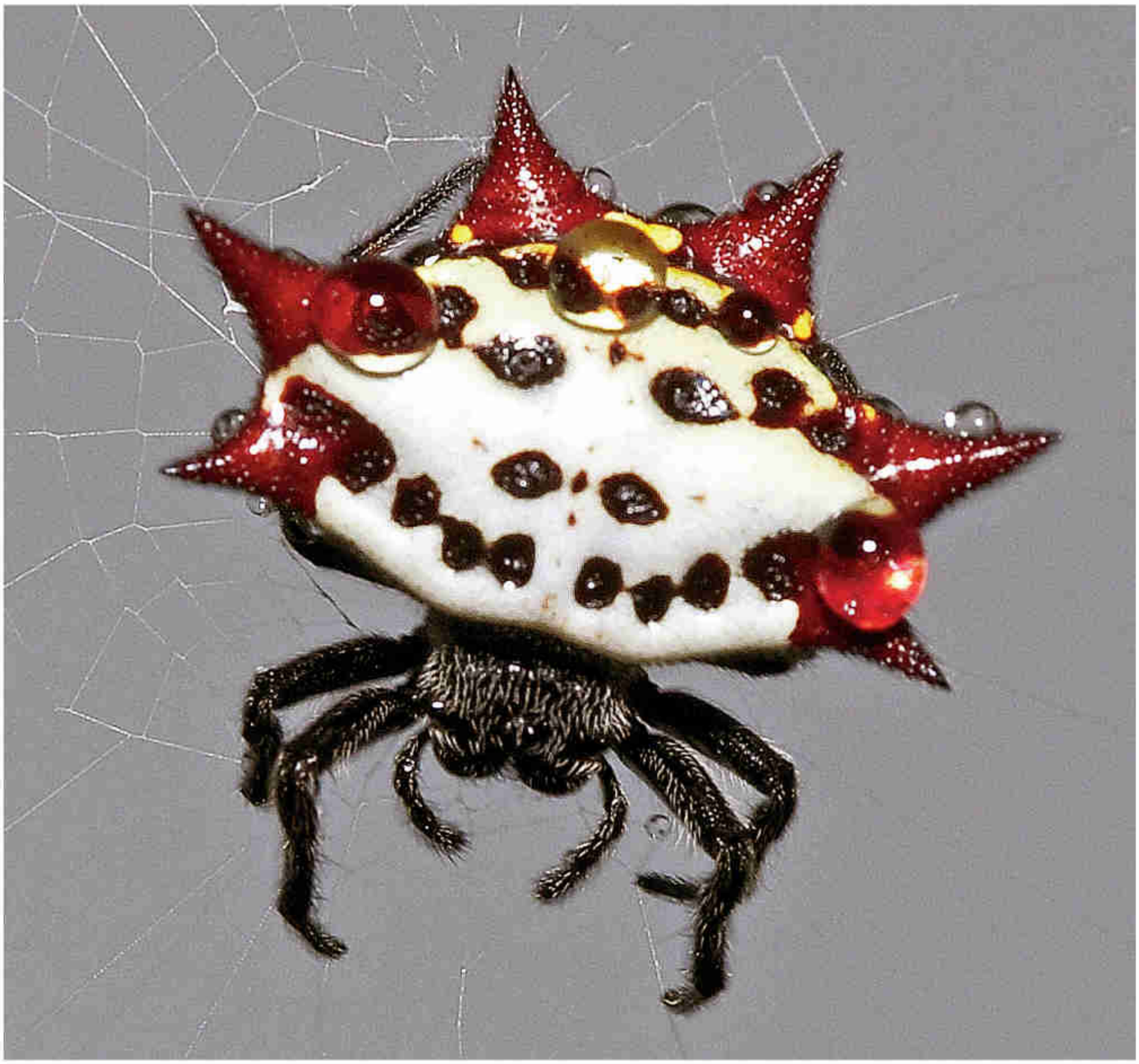
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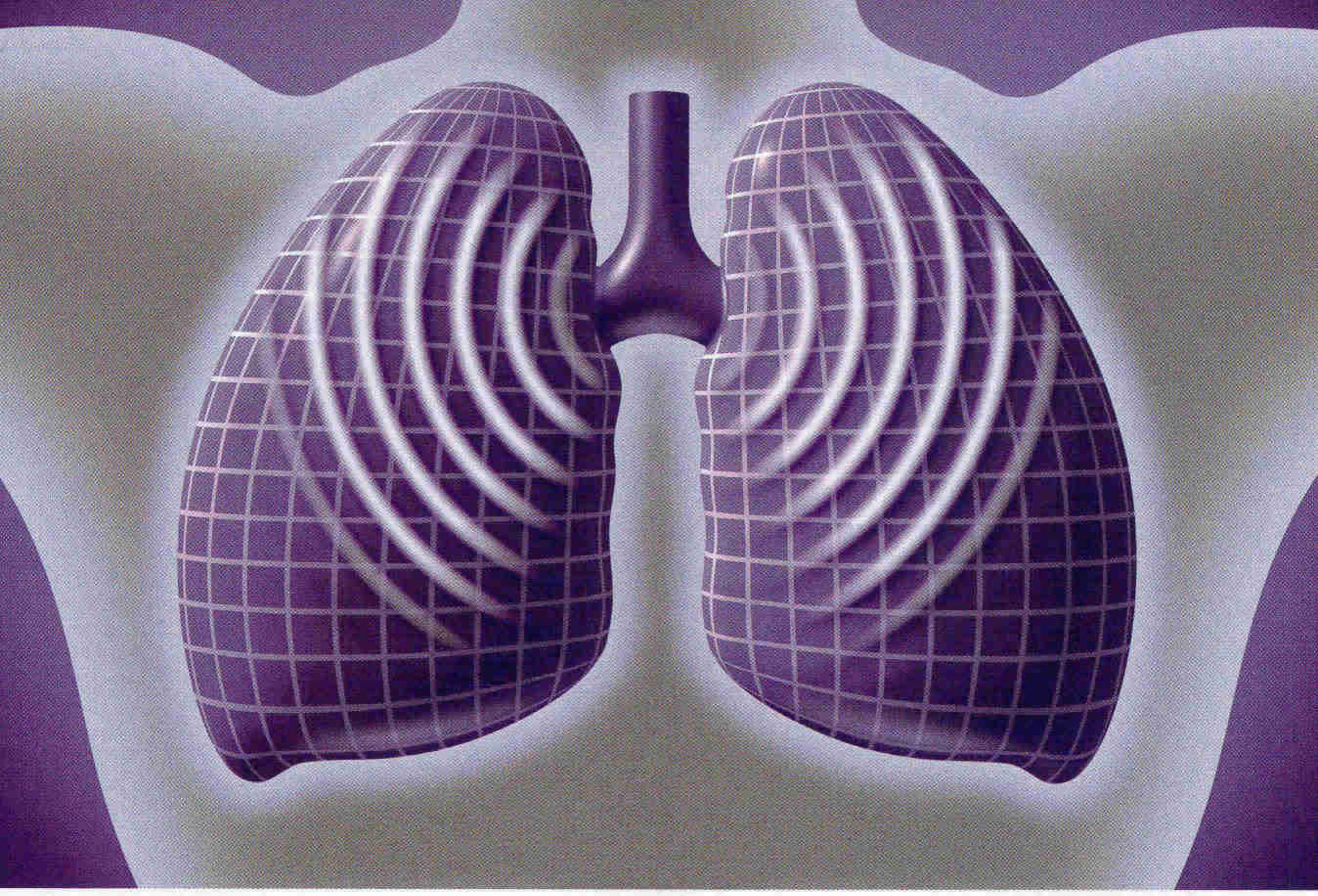
Klaus Eylerts
Miami, Florida

"We don't get too many rainstorms in winter in Miami, so I figured I could take some water droplets on leaves," says Klaus Eylerts, 44, who had headed outside to shoot after a storm. Instead he spotted this orb-weaving spider on a web.



Michael Neu
Rock Island, Tennessee

Freelance photographer Michael Neu, 38, shot this cecropia moth caterpillar on a twig in the butterfly house of Dayton, Ohio's Cox Arboretum.



ADVAIR® helps significantly improve lung function so you can breathe better.*



If you have COPD associated with chronic bronchitis, ADVAIR 250/50 may help.

ADVAIR works differently than other COPD medications. It is the only product with an anti-inflammatory and a bronchodilator working together to help improve lung function. Talk to your doctor and find out if ADVAIR is right for you.

Get your first full prescription FREE.† Go to advairCOPD.com or call 1-800-768-0200.

It is not known how anti-inflammatories work in COPD.

Important Information: ADVAIR DISKUS 250/50 is approved for controlling symptoms and preventing wheezing in adults with COPD associated with chronic bronchitis. The benefit of using ADVAIR DISKUS for longer than 6 months has not been evaluated. You should only take 1 inhalation of ADVAIR DISKUS 250/50 twice a day. Taking higher doses will not provide additional benefits but may increase your chance of certain side effects. Lower respiratory tract infections, including pneumonia, have been reported with ADVAIR. Patients at risk for developing bone loss (osteoporosis) and some eye problems (cataracts or glaucoma) should be aware that use of inhaled corticosteroids, including ADVAIR DISKUS, may increase your risk. You should consider having regular eye exams. ADVAIR DISKUS does not replace fast-acting inhalers for acute symptoms.

* Measured by a breathing test in people taking ADVAIR 250/50, compared with people taking either fluticasone propionate 250 mcg or salmeterol 50 mcg. Maximum effects may take several weeks. Your results may vary.

† See advairCOPD.com for eligibility rules.

Please see accompanying important information about ADVAIR DISKUS 250/50.

If you don't have prescription coverage and can't afford your medicines, visit pparx.org, or call 1-888-4PPA-NOW (1-888-477-2669)

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PPA Partnership for Prescription Assistance

ADVAIR DISKUS 250/50

(fluticasone propionate 250 mcg and salmeterol 50 mcg inhalation powder)

If you smoke and want to quit, you can learn more at way2quit.com.

Important Information about ADVAIR DISKUS

ADVAIR DISKUS® 100/50, 250/50, 500/50

(fluticasone propionate 100, 250, 500 mcg and salmeterol 50 mcg inhalation powder)

What is the most important information I should know about ADVAIR DISKUS?
In patients with asthma, long-acting beta$_2$-agonist medicines such as salmeterol (one of the medications in ADVAIR®) may increase the chance of death from asthma problems. In a large asthma study, more patients who used salmeterol died from asthma problems compared with patients who did not use salmeterol. So ADVAIR is not for patients whose asthma is well controlled on another asthma controller medicine such as low- to medium-dose inhaled corticosteroids or only need a fast-acting inhaler once in a while. Talk with your doctor about this risk and the benefits of treating your asthma with ADVAIR.

ADVAIR should not be used to treat a severe attack of asthma or chronic obstructive pulmonary disease (COPD) requiring emergency medical treatment.

ADVAIR should not be used to relieve sudden symptoms or sudden breathing problems. Always have a fast-acting inhaler with you to treat sudden breathing difficulty. If you do not have a fast-acting inhaler, contact your doctor to have one prescribed for you.

What is ADVAIR DISKUS?
There are two medicines in ADVAIR: Fluticasone propionate, an inhaled anti-inflammatory belonging to a group of medicines commonly referred to as corticosteroids; and salmeterol, a long-acting, inhaled bronchodilator belonging to a group of medicines commonly referred to as beta$_2$-agonists. There are 3 strengths of ADVAIR: 100/50, 250/50, 500/50.

For Asthma
- ADVAIR is approved for the maintenance treatment of asthma in patients 4 years of age and older. ADVAIR should only be used if your doctor decides that another asthma controller medicine alone does not control your asthma or that you need 2 asthma controller medications.
- The strength of ADVAIR approved for patients ages 4 to 11 years who experience symptoms on an inhaled corticosteroid is ADVAIR DISKUS 100/50. All 3 strengths are approved for patients with asthma ages 12 years and older.

For COPD associated with chronic bronchitis
ADVAIR 250/50 is the only approved dose for the maintenance treatment of airflow obstruction in patients with COPD associated with chronic bronchitis. The benefit of using ADVAIR for longer than 6 months has not been evaluated. The way anti-inflammatories work in the treatment of COPD is not well defined.

Who should not take ADVAIR DISKUS?
You should not start ADVAIR if your asthma is becoming significantly or rapidly worse, which can be life threatening. Serious respiratory events, including death, have been reported in patients who started taking salmeterol in this situation, although it is not possible to tell whether salmeterol contributed to these events. This may also occur in patients with less severe asthma.

You should not take ADVAIR if you have had an allergic reaction to it or any of its components (salmeterol, fluticasone propionate, or lactose). Tell your doctor if you are allergic to ADVAIR, any other medications, or food products. If you experience an allergic reaction after taking ADVAIR, stop using ADVAIR immediately and contact your doctor. Allergic reactions are when you experience one or more of the following: choking; breathing problems; swelling of the face, mouth and/or tongue; rash; hives; itching; or welts on the skin.

Tell your doctor about the following:
- If you are using your fast-acting inhaler more often or using more doses than you normally do (e.g., 4 or more inhalations of your fast-acting inhaler for 2 or more days in a row or a whole canister of your fast-acting inhaler in 8 weeks' time), it could be a sign that your asthma is getting worse. If this occurs, tell your doctor immediately.
- If you have been using your fast-acting inhaler regularly (e.g., four times a day). Your doctor may tell you to stop the regular use of these medications.
- If your peak flow meter results decrease. Your doctor will tell you the numbers that are right for you.
- If you have asthma and your symptoms do not improve after using ADVAIR regularly for 1 week.
- If you have been on an oral steroid, like prednisone, and are now using ADVAIR. You should be very careful as you may be less able to heal after surgery, infection, or serious injury. It takes a number of months for the body to recover its ability to make its own steroid hormones after use of oral steroids. Switching from an oral steroid may also unmask a condition previously suppressed by the oral steroid such as allergies, conjunctivitis, eczema, arthritis, and eosinophilic conditions. Symptoms of an eosinophilic condition can include rash, worsening breathing problems, heart complications, and/or feeling of "pins and needles" or numbness in the arms and legs. Talk to your doctor immediately if you experience any of these symptoms.
- Sometimes patients experience unexpected bronchospasm right after taking ADVAIR. This condition can be life threatening and if it occurs, you should immediately stop using ADVAIR and seek immediate medical attention.
- If you have any type of heart disease such as coronary artery disease, irregular heart beat or high blood pressure, ADVAIR should be used with caution. Be sure to talk with your doctor about your condition because salmeterol, one of the components of ADVAIR, may affect the heart by increasing heart rate and blood pressure. It may cause symptoms such as heart fluttering, chest pain, rapid heart rate, tremor, or nervousness.
- If you have seizures, overactive thyroid gland, liver problems, or are sensitive to certain medications for breathing.
- If your breathing problems get worse over time or if your fast-acting inhaler does not work as well for you while using ADVAIR. If your breathing problems worsen quickly, get emergency medical care.
- If you have been exposed to or currently have chickenpox or measles or if you have an immune system problem. Patients using medications that weaken the immune system are more likely to get infections than healthy individuals. ADVAIR contains a corticosteroid (fluticasone propionate) which may weaken the immune system. Infections like chickenpox and measles, for example, can be very serious or even fatal in susceptible patients using corticosteroids.

How should I take ADVAIR DISKUS?
ADVAIR should be used 1 inhalation, twice a day (morning and evening). ADVAIR should never be taken more than 1 inhalation twice a day. The full benefit of taking ADVAIR may take 1 week or longer.

If you miss a dose of ADVAIR, just skip that dose. Take your next dose at your usual time. Do not take two doses at one time.

Do not stop using ADVAIR unless told to do so by your doctor because your symptoms might get worse.

Do not change or stop any of your medicines used to control or treat your breathing problems. Your doctor will adjust your medicines as needed.

When using ADVAIR, remember:
- Never breathe into or take the DISKUS® apart.
- Always use the DISKUS in a level position.
- After each inhalation, rinse your mouth with water without swallowing.
- Never wash any part of the DISKUS. Always keep it in a dry place.
- Never take an extra dose, even if you feel you did not receive a dose.
- Discard 1 month after removal from the foil pouch.
- Do not use ADVAIR with a spacer device.

Children should use ADVAIR with an adult's help as instructed by the child's doctor.

Can I take ADVAIR DISKUS with other medications?
Tell your doctor about all the medications you take, including prescription and nonprescription medications, vitamins, and herbal supplements.

If you are taking ADVAIR DISKUS, do not use other long-acting beta$_2$-agonist–containing medications, such as SEREVENT® DISKUS or Foradil® Aerolizer,® for any reason.

If you take ritonavir (an HIV medication), tell your doctor. Ritonavir may interact with ADVAIR and could cause serious side effects. The anti-HIV medicines Norvir® Soft Gelatin Capsules, Norvir Oral Solution, and Kaletra® contain ritonavir.

No formal drug interaction studies have been performed with ADVAIR.

In clinical studies, there were no differences in effects on the heart when ADVAIR was taken with varying amounts of albuterol. The effect of using ADVAIR in patients with asthma while taking more than 9 puffs a day of albuterol has not been studied.

ADVAIR should be used with extreme caution during and up to 2 weeks after treatment with monoamine oxidase (MAO) inhibitors or tricyclic antidepressants since these medications can cause ADVAIR to have an even greater effect on the circulatory system.

ADVAIR should be used with caution in people who are taking ketoconazole (an antifungus medication) or other drugs broken down by the body in a similar way. These medications can cause ADVAIR to have greater steroid side effects.

Generally, people with asthma should not take beta-blockers because they counteract the effects of beta$_2$-agonists and may also cause severe bronchospasm. However, in some cases, for instance, following a heart attack, selective beta-blockers may still be used if there is no acceptable alternative.

The ECG changes and/or low blood potassium that may occur with some diuretics may be made worse by ADVAIR, especially at higher-than-recommended doses. Caution should be used when these drugs are used together.

In clinical studies, there was no difference in side effects when ADVAIR was taken with methylxanthines (e.g., theophylline) or with FLONASE® (fluticasone propionate).

What are other important safety considerations with ADVAIR DISKUS?
Osteoporosis: Long-term use of inhaled corticosteroids may result in bone loss (osteoporosis). Patients who are at risk for increased bone loss (tobacco use, advanced age, inactive lifestyle, poor nutrition, family history of osteoporosis, or long-term use of drugs such as corticosteroids) may have a greater risk with ADVAIR. If you have risk factors for bone loss, you should talk to your doctor about ways to reduce your risk and whether you should have your bone density evaluated.

Glaucoma and cataracts: Glaucoma, increased pressure in the eyes, and cataracts have been reported with the use of inhaled steroids, including fluticasone propionate, a medicine contained in ADVAIR. Regular eye examinations should be considered if you are taking ADVAIR.

Lower respiratory tract infection: Lower respiratory tract infections, including pneumonia, have been reported with the use of inhaled corticosteroids, including ADVAIR.

Blood sugar: Salmeterol may affect blood sugar and/or cause low blood potassium in some patients, which could lead to a side effect like an irregular heart rate. Significant changes in blood sugar and blood potassium were seen infrequently in clinical studies with ADVAIR.

Growth: Inhaled steroids may cause a reduction in growth velocity in children and adolescents.

Steroids: Taking steroids can affect your body's ability to make its own steroid hormones, which are needed during infections and times of severe stress to your body, such as an operation. These effects can sometimes be seen with inhaled steroids (but it is more common with oral steroids), especially when taken at higher-than-recommended doses over a long period of time. In some cases, these effects may be severe. Inhaled steroids often help control symptoms with less side effects than oral steroids.

Yeast infections: Patients taking ADVAIR may develop yeast infections of the mouth and/or throat ("thrush") that should be treated by their doctor.

Tuberculosis or other untreated infections: ADVAIR should be used with caution, if at all, in patients with tuberculosis, herpes infections of the eye, or other untreated infections.

What are the other possible side effects of ADVAIR DISKUS?
ADVAIR may produce side effects in some patients. In clinical studies, the most common side effects with ADVAIR included:

- Respiratory infections
- Throat irritation
- Hoarseness
- Sinus infection
- Yeast infection of the mouth
- Bronchitis
- Cough
- Headaches
- Nausea and vomiting
- Diarrhea
- Musculoskeletal pain
- Dizziness
- Fever
- Ear, nose, and throat infections
- Nosebleed

Tell your doctor about any side effect that bothers you or that does not go away. These are not all the side effects with ADVAIR. Ask your doctor or pharmacist for more information.

What if I am pregnant, planning to become pregnant, or nursing?
Talk to your doctor about the benefits and risks of using ADVAIR during pregnancy, labor, or if you are nursing. There have been no studies of ADVAIR used during pregnancy, labor, or in nursing women. Salmeterol is known to interfere with labor contractions. It is not known whether ADVAIR is excreted in breast milk, but other corticosteroids have been detected in human breast milk. Fluticasone propionate, like other corticosteroids, has been associated with birth defects in animals (e.g., cleft palate and fetal death). Salmeterol showed no effect on fertility in rats at 180 times the maximum recommended daily dose.

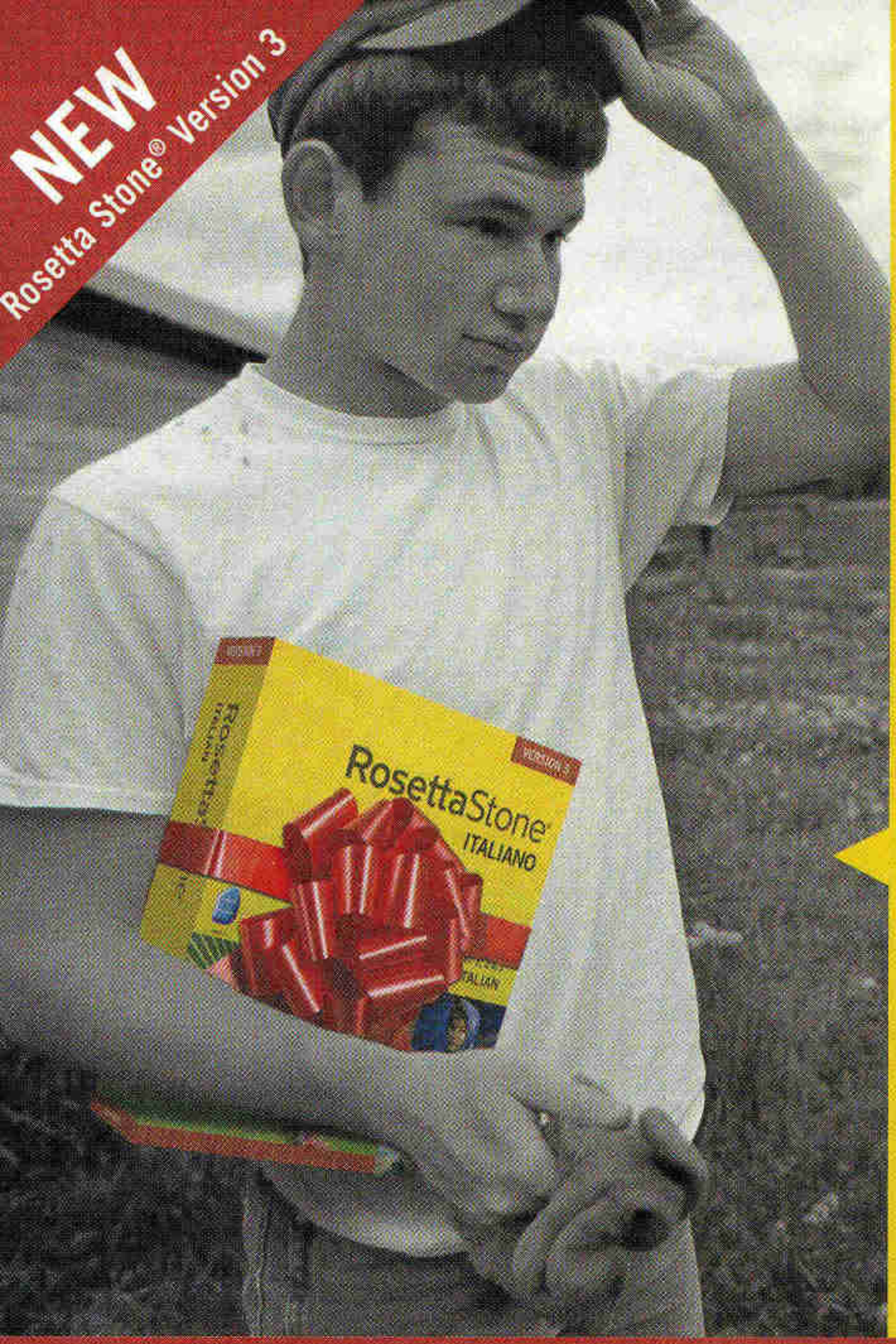
What other important tests were conducted with ADVAIR?
There is no evidence of enhanced toxicity with ADVAIR compared with the components administered separately. In animal studies with doses much higher than those used in humans, salmeterol was associated with uterine tumors. Your healthcare professional can tell you more about how drugs are tested on animals and what the results of these tests may mean to your safety.

For more information on ADVAIR DISKUS
This page is only a brief summary of important information about ADVAIR DISKUS. For more information, talk to your doctor. You can also visit www.ADVAIR.com or call 1-888-825-5249. Patients receiving ADVAIR DISKUS should read the medication guide provided by the pharmacist with the prescription.

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Women in Pohulyanka, Ukraine, gather to kiss the cross during an outdoor religious celebration.

Carolyn Drake's story on the Lubavitch Jews in Brooklyn, New York, appeared in the February 2006 issue of National Geographic. *She is now a freelancer based in Istanbul, Turkey.*

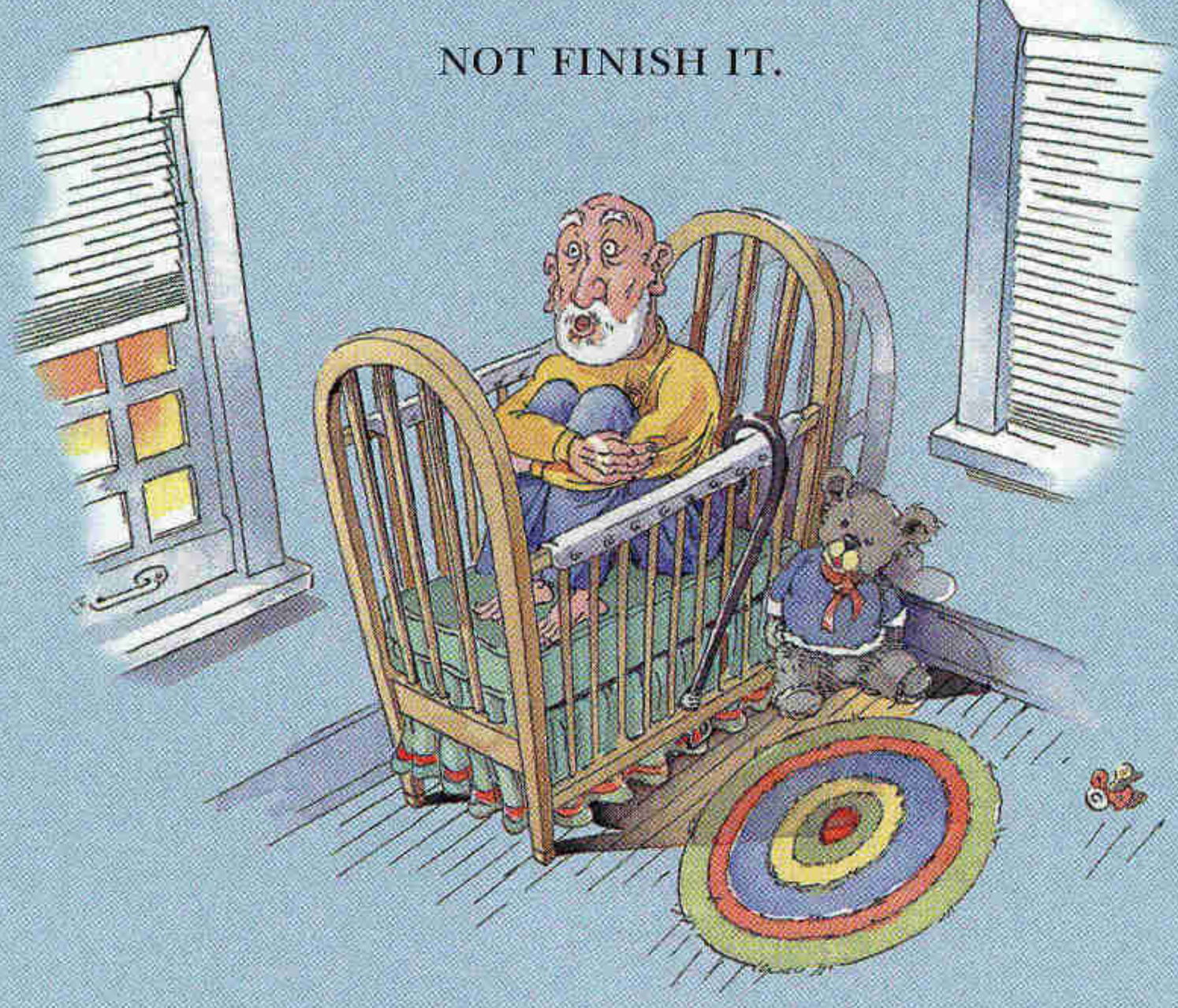
Changing Ukraine I spent 2006 in Ukraine on a Fulbright fellowship. I'd proposed a project focusing on women, comparing generations through photography to see how the transition from state socialism to a more democratic government is affecting gender roles. But I ended up not limiting my work to women. I realized you can't understand women's situations without looking at them in relation to men.

Many villages in Ukraine have been shrinking as young people leave to find work in nearby cities, where some rural traditions are being transplanted. It was in the remote northwest corner of the country that I photographed these women. After church, the women and men gathered in a circle outside, carrying baskets overflowing with flowers and apples. The priest walked around blessing people. When he finished, the women crowded in front of him, and he held out the cross for them to kiss. I didn't see any men participate in this part of the ceremony. I think it shows something about women bearing responsibility for passing down culture and tradition.

The church, and along with it gender differentiation, have revived since 1991, filling part of the ideological vacuum left after the Soviet Union collapsed. These kinds of changes have added variety to the world—and in my view, a world of variety is more photogenic. But these changes have also added a new set of social issues.

Bald, helpless and broke is how to *start life.*

NOT FINISH IT.



People tend to have a rosy view of their retirement savings. "I'll live off my pension." "I've got equity in my house." "The older you get, the cheaper it is to live." But these innocent assumptions can be quickly shattered. Luckily, Allstate has a few ideas on how America can start getting ready.

1. EXAMINE SOCIAL SECURITY.
Americans will not be able to rely solely on Social Security for a comfortable retirement. In the future, it's projected to cover an increasingly small percentage of the average retirement. There's debate as to whether it should be repaired or replaced. But what's clear is we need to reform Social Security now.

2. BOOST RETIREMENT PLAN ENROLLMENT.
Companies should continue looking for ways to encourage employee participation in 401(k) plans. One proven way to increase retirement savings is through company matches. Another is automatic enrollment—employees are signed up for savings plans when they join the company, unless they specifically opt out.

3. INCREASE PERSONAL SAVINGS.
Ultimately, everyone is responsible for their own retirement. It's why we support laws that reward people for saving. **Tax-advantaged savings vehicles like annuities and IRAs are two examples of products that can help allay Baby Boomers' biggest fear: living to see the well run dry.**

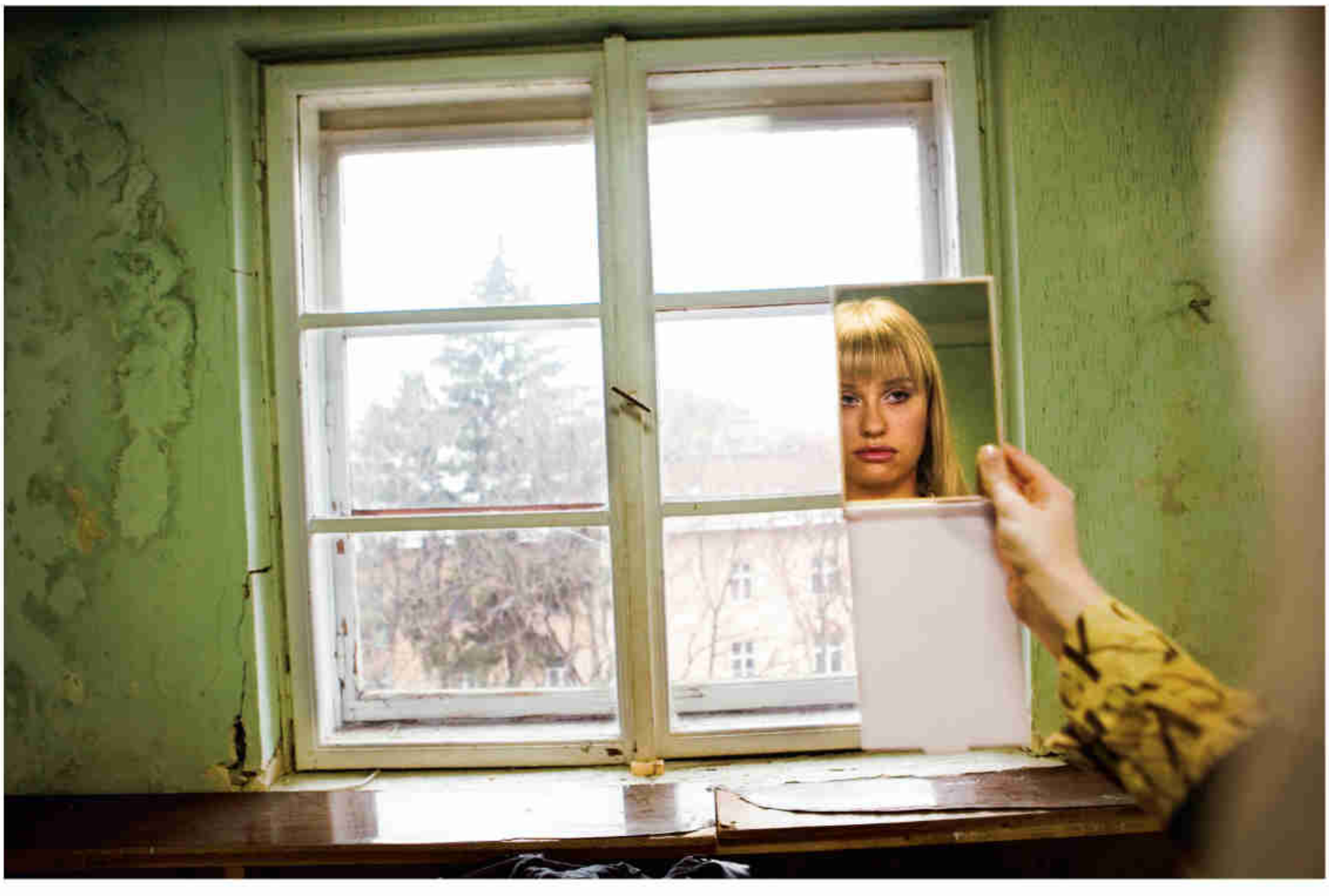
When planning for retirement, it's time to realize that no one is going to take care of us unless we start taking care of ourselves.

Let's save retirement by saving for retirement.
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PHOTO JOURNAL | CAROLYN DRAKE



Aspiring model Alena Dobrokhotova checks herself before her school portrait is taken in a classroom of the accounting college where she studies. I first met her when she was participating in the Miss Lviv beauty contest. Economic opportunities can be limited for Ukrainian women in a job market where connections are everything.



It was a hot summer afternoon in the Crimean steppe village of Sary-Bash. Some men had just killed a cow to feed guests at a wedding that night. I was photographing them cutting the slabs of meat, and before I realized it, they were finished and carrying it away in a bowl. They put it in the backseat of this car and drove off.

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SHOOT. CREATE. SHARE.



Circles of baklava dough rest on the floor of a former classroom in Uzkut. This woman was living as a squatter in an abandoned school, making bits of money by selling pastries to tourists at nearby Crimean beaches. Like other Crimean Tatars, her relatives were deported mainly to Central Asia in 1944. Thousands of them have returned to their homeland during the past 15 years, but many still can't afford homes.

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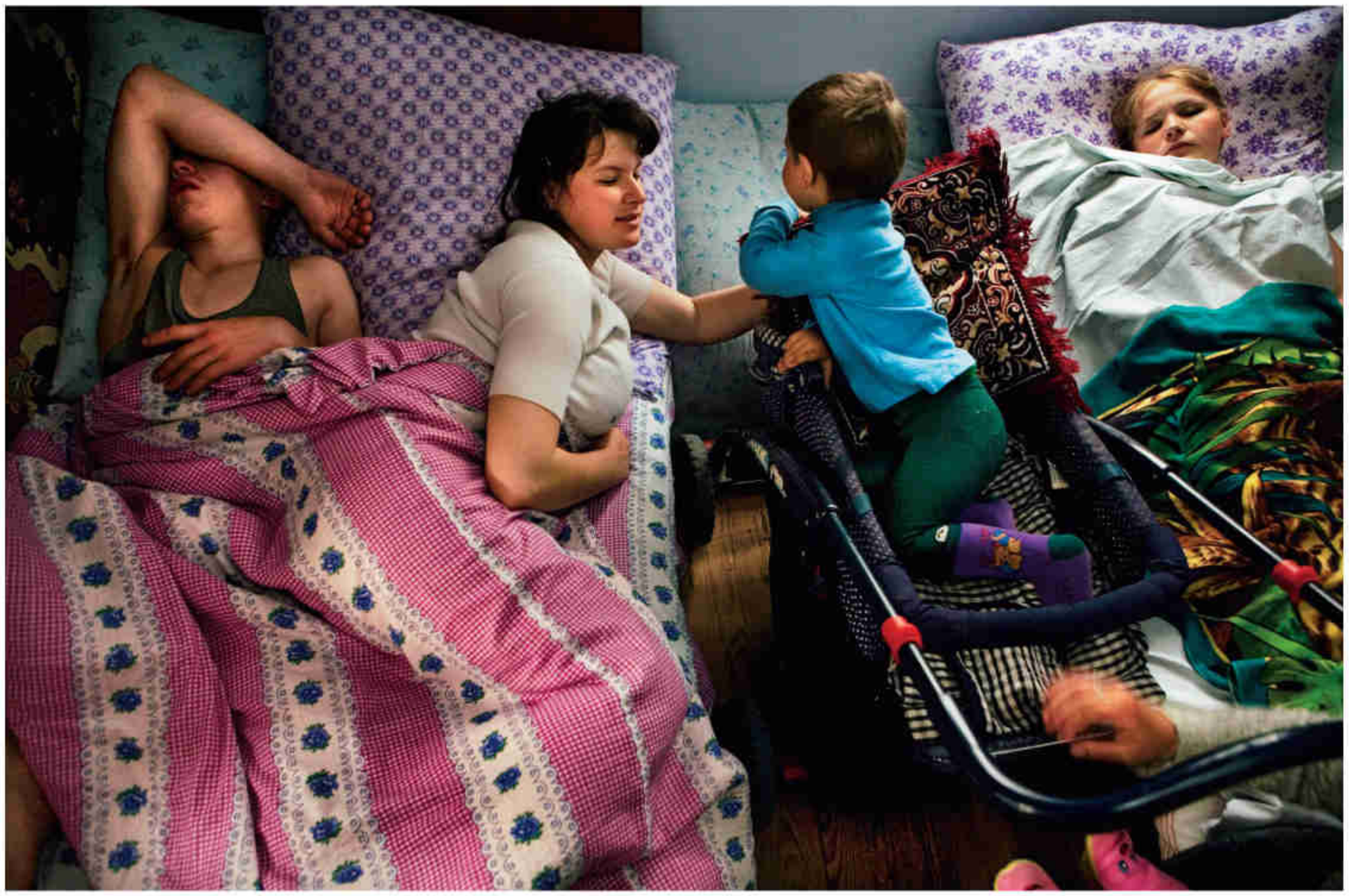
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PHOTO JOURNAL | CAROLYN DRAKE



Sunday morning in Krasiv: Mariya Derzhylo, her husband asleep beside her, greets a young nephew. The couple was visiting her mother's home. Mariya's younger sister and the child's mother also slept in the room that night. Close quarters are normal in Ukraine. It is a socially connected place, with a strong sense of family.



Everywhere I went around Volhynia I saw people harvesting hay. I took this picture in Pohulyanka at the end of the day. The men looked exhausted, but they were lucky to have a machine for cutting. Many others have to do it by hand. This guy was throwing hay up in a huge pile on a wagon as it was chopped and spewed by the machine.



South American Tapir *(Tapirus terrestris)*
Size: Head and body length, 66.9 - 78.7 inches; shoulder height, 30.3 - 42.5 inches; tail, 3.1 inches
Weight: 550 - 770 lbs. **Habitat:** Most often found in river areas in moist lowland rainforests
Surviving number: Unknown; populations declining

Photographed by Pete Oxford

WILDLIFE AS CANON SEES IT

This nose is nothing to sniff at. Blessed with a prehensile proboscis, the South American tapir takes full advantage of it to pick fruit, strip leaves, "snorkel" while swimming and even whistle to call for mates. The solitary herbivore often lifts its nose as though sniffing for trouble on the wind, and only breaks its cover at dawn and dusk. But this natural caution is foiled by its habit of always taking the same path to its feeding grounds, creating a trail that betrays its presence. Poaching, persistent habitat loss and fatal run-ins with vehicles on dark roads all combine to throw the tapir's survival into serious question.

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VISIONS OF EARTH



Brazil Butterflies spatter the shoreline of the Juruena River in Brazil's new 4.7-million-acre Juruena National Park. Several different species flock to the riverbanks to sip mineral salts from the sand.

PHOTO: ZIG KOCH



Iceland Branches of the Kolgrima River flow across flatlands leading from Vatnajökull—Iceland's largest glacier—to the sea. Milky tones in the water are from pale silt; the blue is a reflection of the sky.

PHOTO: HANS STRAND, CORBIS



Democratic Republic of the Congo The silverback Senkwekwe, one of six mountain gorillas slain in Virunga National Park last July, is carried from the crime scene. Fewer than 700 remain in the wild.



How to Help For information on protecting mountain gorillas, go to page 156.

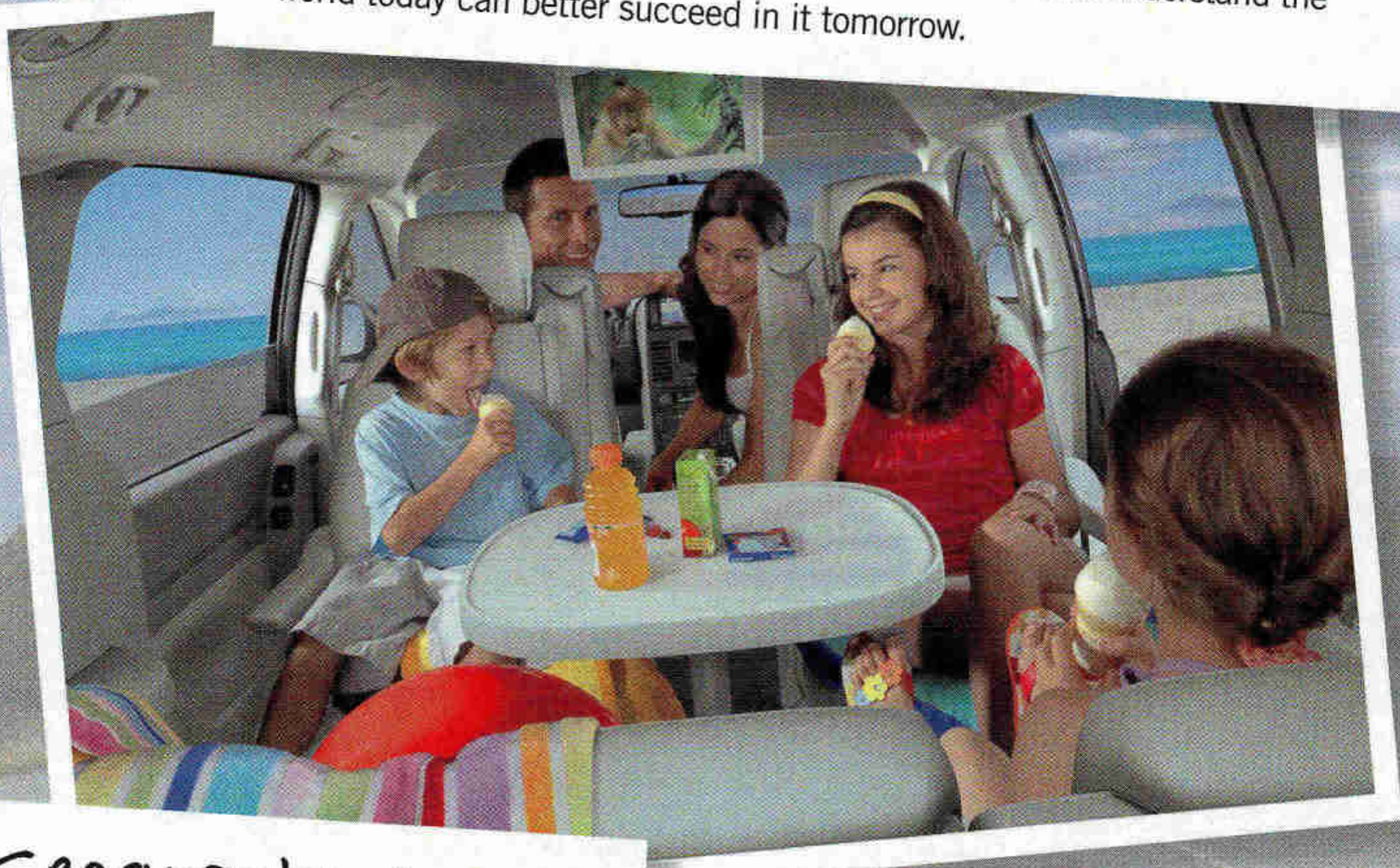
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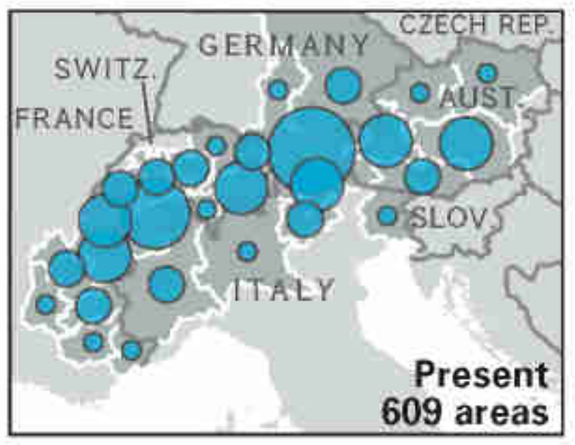
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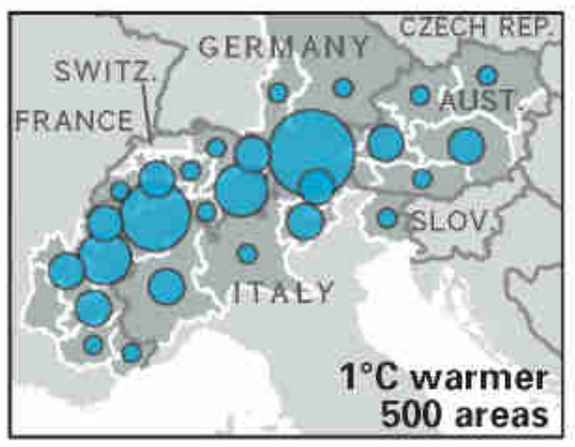
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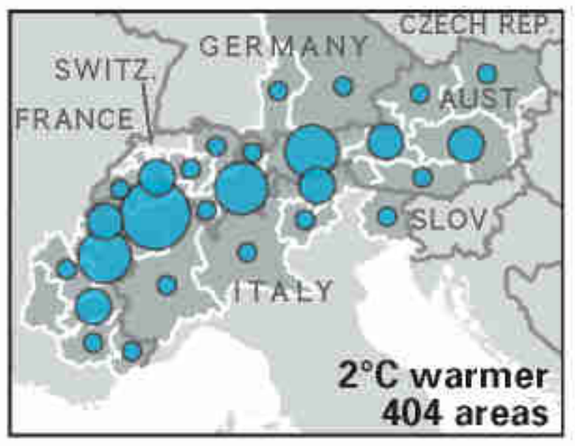
[1]Always check entire surroundings before backing up. [2]GPS mapping may not be detailed in all areas or reflect current road regulations. See your dealer for details. [3]Seat must always be locked in forward- or rear-facing mode while vehicle is in motion. [4]Always drive carefully, consistent with conditions. Always wear your seat belt and obey traffic laws. [5]Always use seat belts. Children 12 and under should always be in a backseat correctly using an infant or child restraint system, or the seat belt positioned correctly for the child's age and size. ©2007 SIRIUS Satellite Radio Inc. "SIRIUS", "SIRIUS Backseat TV", the SIRIUS dog logo and all related marks are trademarks of SIRIUS Satellite Radio Inc. All other trademarks, service marks and logos are the property of their respective owners. ©2007 Viacom International Inc. All Rights Reserved. Nickelodeon and all related titles, logos and characters are trademarks of Viacom International Inc. DISNEY CHANNEL and The DISNEY CHANNEL LOGO are trademarks of Disney Enterprises Inc. and are used with permission. TM and ©Cartoon Network.

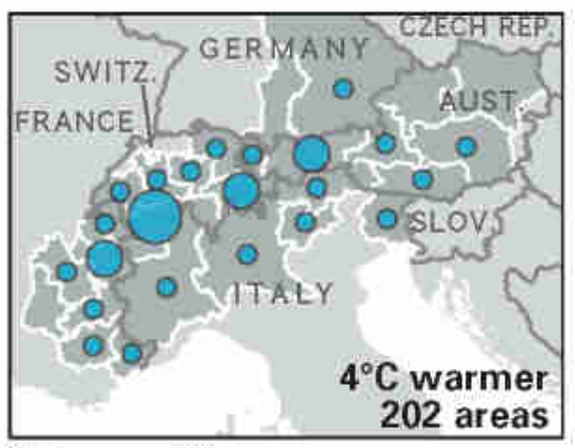
Skiing Goes Downhill Some slopes in the Alps were all but unskiable in December 2006. Unseasonably high temperatures meant plenty of rain and mud but practically no snow. Dropping mercury early this year ensured that the European ski season wasn't a complete washout, but it wasn't enough to rescue the Abondance ski station in France. This year, the town's council voted to shut the facility because of a shortfall of snow. Things aren't much better for cold-weather resorts in the U.S. Average temperatures are steadily rising—2006 was the second warmest year in more than a century—and snow cover is becoming scarcer. The biggest ski resorts have slashed their number of days in operation, from an average of 158 a decade ago, to 146 in 2005-06. What to do about the snow deficit? Many ski areas are relying more on their artificial snowmaking, but artificial snow can be pricey—and requires cool temperatures to work as a ski surface. Other resorts are focusing more on warm-weather activities like golf and mountain biking. But that won't bring back the winters. "We used to be able to count on snow," says Lisa Isaacs, an environmental programs director for California's Mammoth Mountain ski area. "Now the only thing we can count on is that we can't count on the snow." *—Christopher Elliott*











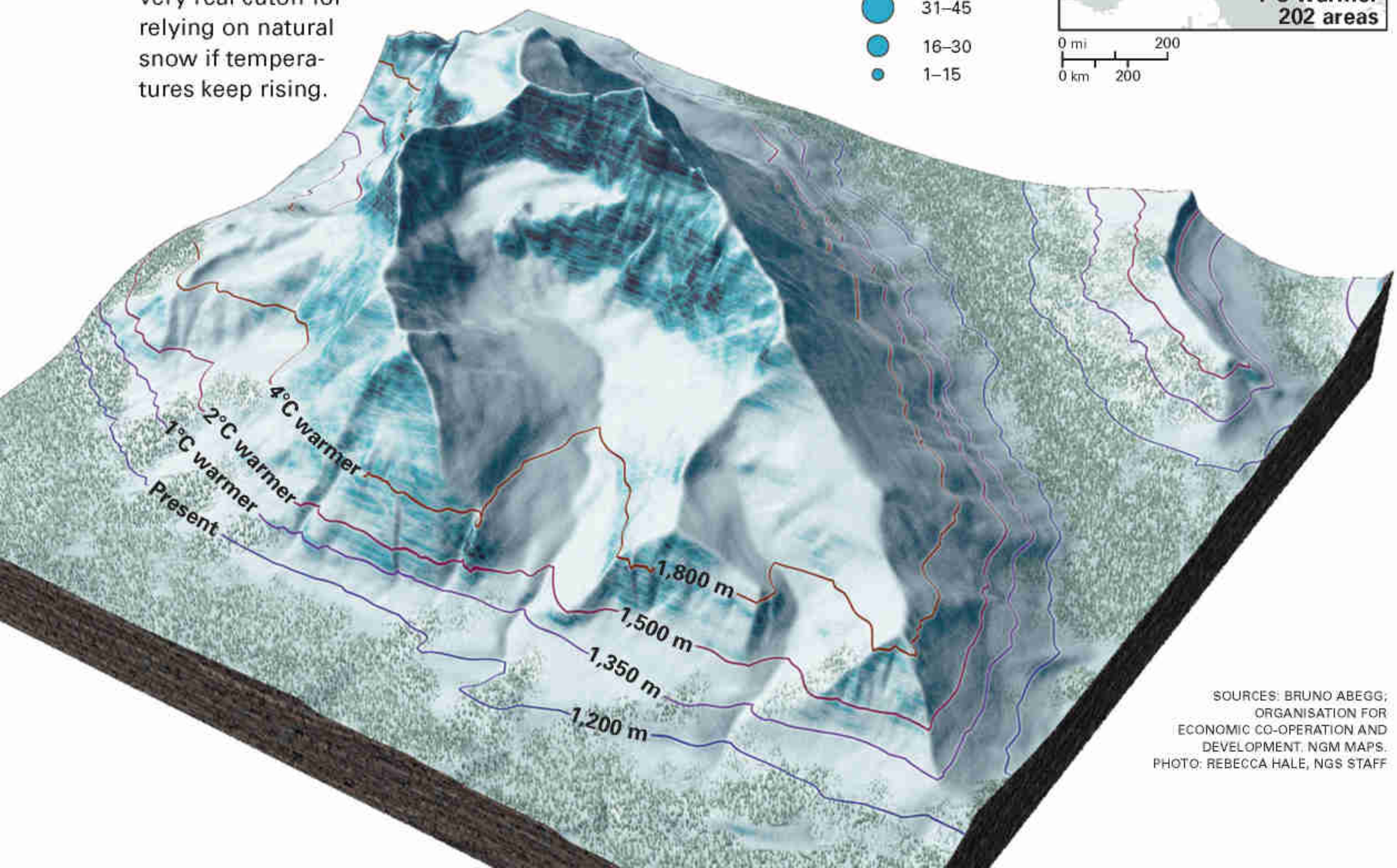
Ski region

Number of ski areas that can rely on natural snow

61–75
46–60
31–45
16–30
1–15

0 mi 200
0 km 200

On this imaginary Alpine peak, the lines show the very real cutoff for relying on natural snow if temperatures keep rising.



SOURCES: BRUNO ABEGG; ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT. NGM MAPS. PHOTO: REBECCA HALE, NGS STAFF

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*Helps you wake up less frequently and fall back to sleep faster. Proven effective for up to 7 hours in clinical studies.

AMBIEN CR is indicated for the treatment of insomnia.

IMPORTANT SAFETY INFORMATION

AMBIEN CR is a treatment option you and your healthcare provider can consider along with lifestyle changes and can be taken for as long as your provider recommends. Until you know how AMBIEN CR will affect you, you shouldn't drive or operate machinery. Be sure you're able to devote 7 to 8 hours to sleep before being active again. Sleepwalking, and eating or driving while not fully awake, with amnesia for the event, have been reported. If you experience any of these behaviors contact your provider immediately. In rare cases, sleep medicines may cause allergic reactions such as swelling of your tongue or throat, shortness of breath, or more severe results. If you have an allergic reaction while using AMBIEN CR, contact your doctor immediately. Side effects may include next-day drowsiness, dizziness, and headache. It's non-narcotic; however, like most sleep medicines, it has some risk of dependency. Don't take it with alcohol.

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6.25-MG & 12.5-MG EXTENDED RELEASE TABLETS

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Please see Important Patient Information on adjoining page.

INFORMATION FOR PATIENTS
Ambien CR® ℞
(zolpidem tartrate extended-release) tablets



INFORMATION FOR PATIENTS TAKING AMBIEN CR

Your doctor has prescribed Ambien CR to help you sleep. The following information is intended to guide you in the safe use of this medicine. It is not meant to take the place of your doctor's instructions. If you have any questions about Ambien CR tablets be sure to ask your doctor or pharmacist.

Ambien CR is used to treat different types of sleep problems, such as:

- trouble falling asleep
- waking up often during the night

Some people may have more than one of these problems.

Ambien CR belongs to a group of medicines known as the "sedative/hypnotics", or simply, sleep medicines. There are many different sleep medicines available to help people sleep better. Sleep problems are usually temporary, requiring treatment for only a short time, usually 1 or 2 days up to 1 or 2 weeks. Some people have chronic sleep problems that may require more prolonged use of sleep medicine. However, you should not use these medicines for long periods without talking with your doctor about the risks and benefits of prolonged use.

SIDE EFFECTS

Most common side effects:

- headache
- somnolence (sleepiness)
- dizziness

You may find that these medicines make you sleepy during the day. How drowsy you feel depends upon how your body reacts to the medicine, which sleep medicine you are taking, and how large a dose your doctor has prescribed. Daytime drowsiness is best avoided by taking the lowest dose possible that will still help you sleep at night. Your doctor will work with you to find the dose of Ambien CR that is best for you.

To manage these side effects while you are taking this medicine:

- When you first start taking Ambien CR or any other sleep medicine until you know whether the medicine will still have some carryover effect in you the next day, use extreme care while doing anything that requires complete alertness, such as driving a car, operating machinery, or piloting an aircraft.
- NEVER drink alcohol while you are being treated with Ambien CR or any sleep medicine. Alcohol can increase the side effects of Ambien CR or any other sleep medicine.
- Do not take any other medicines without asking your doctor first. This includes medicines you can buy without a prescription. Some medicines can cause drowsiness and are best avoided while taking Ambien CR.
- Always take the exact dose of Ambien CR prescribed by your doctor. Never change your dose without talking to your doctor first.

SPECIAL CONCERNS

There are some special problems that may occur while taking sleep medicines.

"Sleep-Driving" and other complex behaviors: There have been reports of people getting out of bed after taking a sleep medicine and driving their cars while not fully awake, often with no memory of the event. If you experience such an event, it should be reported to your doctor immediately, since "sleep-driving" can be dangerous. This behavior is more likely to occur when Ambien CR is taken with alcohol or other drugs such as those for the treatment of depression or anxiety. Other complex behaviors such as preparing and eating food, making phone calls, or having sex have been reported in people who are not fully awake after taking a sleep medicine. As with "sleep-driving", people usually do not remember these events.

Memory problems: Sleep medicines may cause a special type of memory loss or "amnesia." When this occurs, a person may not remember what has happened for several hours after taking the medicine. This is usually not a problem since most people fall asleep after taking the medicine.

Memory loss can be a problem, however, when sleep medicines are taken while traveling, such as during an airplane flight and the person wakes up before the effect of the medicine is gone. This has been called "traveler's amnesia."

Be sure to talk to your doctor if you think you are having memory problems. Although memory problems are not very common while taking Ambien CR, in most instances, they can be avoided if you take Ambien CR only when you are able to get a full night's sleep (7 to 8 hours) before you need to be active again.

Tolerance: When sleep medicines are used every night for more than a few weeks, they may lose their effectiveness to help you sleep. This is known as "tolerance". Sleep medicines should, in most cases, be used only for short periods of time, such as 1 or 2 days and generally no longer than 1 or 2 weeks. If your sleep problems continue, consult your doctor, who will determine whether other measures are needed to overcome your sleep problems.

Dependence: Sleep medicines can cause dependence, especially when these medicines are used regularly for longer than a few weeks or at high doses. Some people develop a need to continue taking their medicines. This is known as dependence or "addiction."

When people develop dependence, they may have difficulty stopping the sleep medicine. If the medicine is suddenly stopped, the body is not able to function normally and unpleasant symptoms may occur (see *Withdrawal*). They may find that they have to keep taking the medicines either at the prescribed dose or at increasing doses just to avoid withdrawal symptoms.

All people taking sleep medicines have some risk of becoming dependent on the medicine. However, people who have been dependent on alcohol or other drugs in the past may have a higher chance of becoming addicted to sleep medicines. This possibility must be considered before using these medicines for more than a few weeks.

If you have been addicted to alcohol or drugs in the past, it is important to tell your doctor before starting Ambien CR or any sleep medicine.

Withdrawal: Withdrawal symptoms may occur when sleep medicines are stopped suddenly after being used daily for a long time. In some cases, these symptoms can occur even if the medicine has been used for only a week or two.

In mild cases, withdrawal symptoms may include unpleasant feelings. In more severe cases, abdominal and muscle cramps, vomiting, sweating, shakiness, and rarely, seizures may occur. These more severe withdrawal symptoms are very uncommon.

Another problem that may occur when sleep medicines are stopped is known as "rebound insomnia." This means that a person may have more trouble sleeping the first few nights after the medicine is stopped than before starting the medicine. If you should experience rebound insomnia, do not get discouraged. This problem usually goes away on its own after 1 or 2 nights.

If you have been taking Ambien CR or any other sleep medicine for more than 1 or 2 weeks, do not stop taking it on your own. Always follow your doctor's directions.

Changes in behavior and thinking: Some people using sleep medicines have experienced unusual changes in their thinking and/or behavior. These effects are not common. However, they have included:

- more outgoing or aggressive behavior than normal
- confusion
- strange behavior
- agitation
- hallucinations
- worsening of depression
- suicidal thoughts

How often these effects occur depends on several factors, such as a person's general health, the use of other medicines, and which sleep medicine is being used.

It is also important to realize that it is rarely clear whether these behavior changes are caused by the medicine, an illness, or occur on their own. In fact, sleep problems that do not improve may be due to illnesses that were present before the medicine was used. If you or your family notice any changes in your behavior, or if you have any unusual or disturbing thoughts, call your doctor immediately.

Pregnancy: Sleep medicines may cause sedation of the unborn baby when used during the last weeks of pregnancy.

Be sure to tell your doctor if you are pregnant, if you are planning to become pregnant, or if you become pregnant while taking Ambien CR.

SAFE USE OF SLEEPING MEDICINES

To ensure the safe and effective use of Ambien CR or any other sleep medicine, you should observe the following cautions:

1. Ambien CR is a prescription medicine and should be used ONLY as directed by your doctor. Follow your doctor's instructions about how to take, when to take, and how long to take Ambien CR. Ambien CR tablets should not be divided, crushed, or chewed, and must be swallowed whole.
2. Never use Ambien CR or any other sleep medicine for longer than directed by your doctor.
3. If you develop an allergic reaction such as rash, hives, shortness of breath or swelling of your tongue or throat when using Ambien CR or any other sleep medicine, discontinue Ambien CR or other sleep medicine immediately and contact your doctor.
4. If you notice any unusual and/or disturbing thoughts or behavior during treatment with Ambien CR or any other sleep medicine, contact your doctor.
5. Tell your doctor about any medicines you may be taking, including medicines you may buy without a prescription. You should also tell your doctor if you drink alcohol. DO NOT use alcohol while taking Ambien CR or any other sleep medicine.
6. Do not take Ambien CR unless you are able to get a full night's sleep before you must be active again. For example, Ambien CR should not be taken on an overnight airplane flight of less than 7 to 8 hours since "traveler's amnesia" may occur.
7. Do not increase the prescribed dose of Ambien CR or any other sleep medicine unless instructed by your doctor.
8. When you first start taking Ambien CR or any other sleep medicine, until you know whether the medicine will still have some carryover effect in you the next day, use extreme care while doing anything that requires complete alertness, such as driving a car, operating machinery, or piloting an aircraft.
9. Be aware that you may have more sleeping problems the first night after stopping Ambien CR or any other sleep medicine.
10. Be sure to tell your doctor if you are pregnant, if you are planning to become pregnant, or if you become pregnant while taking Ambien CR or any other sleep medicine.
11. As with all prescription medicines, never share Ambien CR or any other sleep medicine with anyone else. Always store Ambien CR or any other sleep medicine in the original container that you received it in and store it out of reach of children.
12. Ambien CR works very quickly. You should only take Ambien CR right before going to bed and are ready to go to sleep.

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—George Thomas
Towson Watch Company

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I'll take mine black...no sugar

In the early 1930s, watch manufacturers took a clue from Henry Ford's favorite quote concerning his automobiles, "You can have any color as long as it is black." Black dialed watches became the rage especially with pilots and race drivers. Of course, since the multi-functional black dial watch went well with a black tuxedo, this adventurer's timepiece easily moved from the airplane hangar to dancing at the nightclub. Now, Stauer brings back the "Noire", a design based on an elegant timepiece built in 1936. The rare black dialed, complex automatics from the 1930s have recently hit new heights at auction. One was sold for in excess of $600,000. We thought that you might like to have an affordable version that will be much more accurate than the original.



The 27 jewels and hand-assembled parts inside drive this classic masterpiece.

Basic black with a twist. Not only are the dial, hands and face vintage, but we used a 27-jeweled automatic movement. This is the kind of engineering desired by fine watch collectors worldwide. But since we design this classic movement on state of the art computer-controlled Swiss built machines, the accuracy is excellent. Three interior complications display day, month and date. The crocodile embossed leather band is adjustable from 6 1/2" to 9", fitting almost any wrist. And the screw-down crown keeps the watch water resistant to 5 atms. The Stauer Noire was designed by Michael Bisceglia, one of America's top watch historians who hosts a national historical timepiece television show. We have priced the luxurious Stauer Noire to keep you in the black. So slip into the back of your black limousine, savor some rich tasting black coffee and look at your wrist knowing that you have some great time on your hands.

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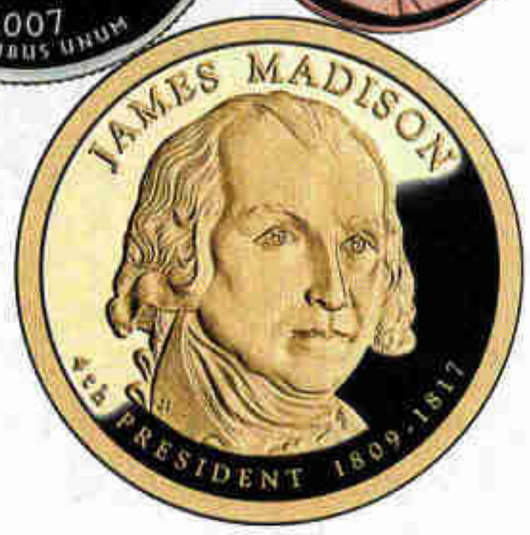
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PHOTO: STEVE TOLAN



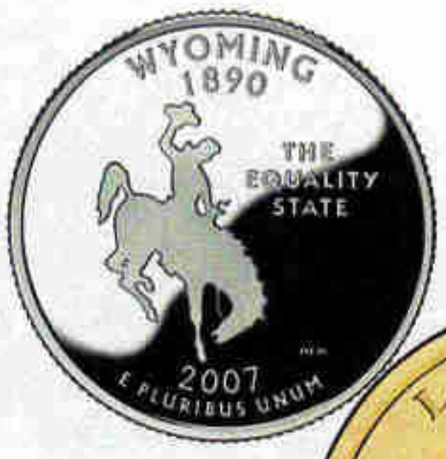








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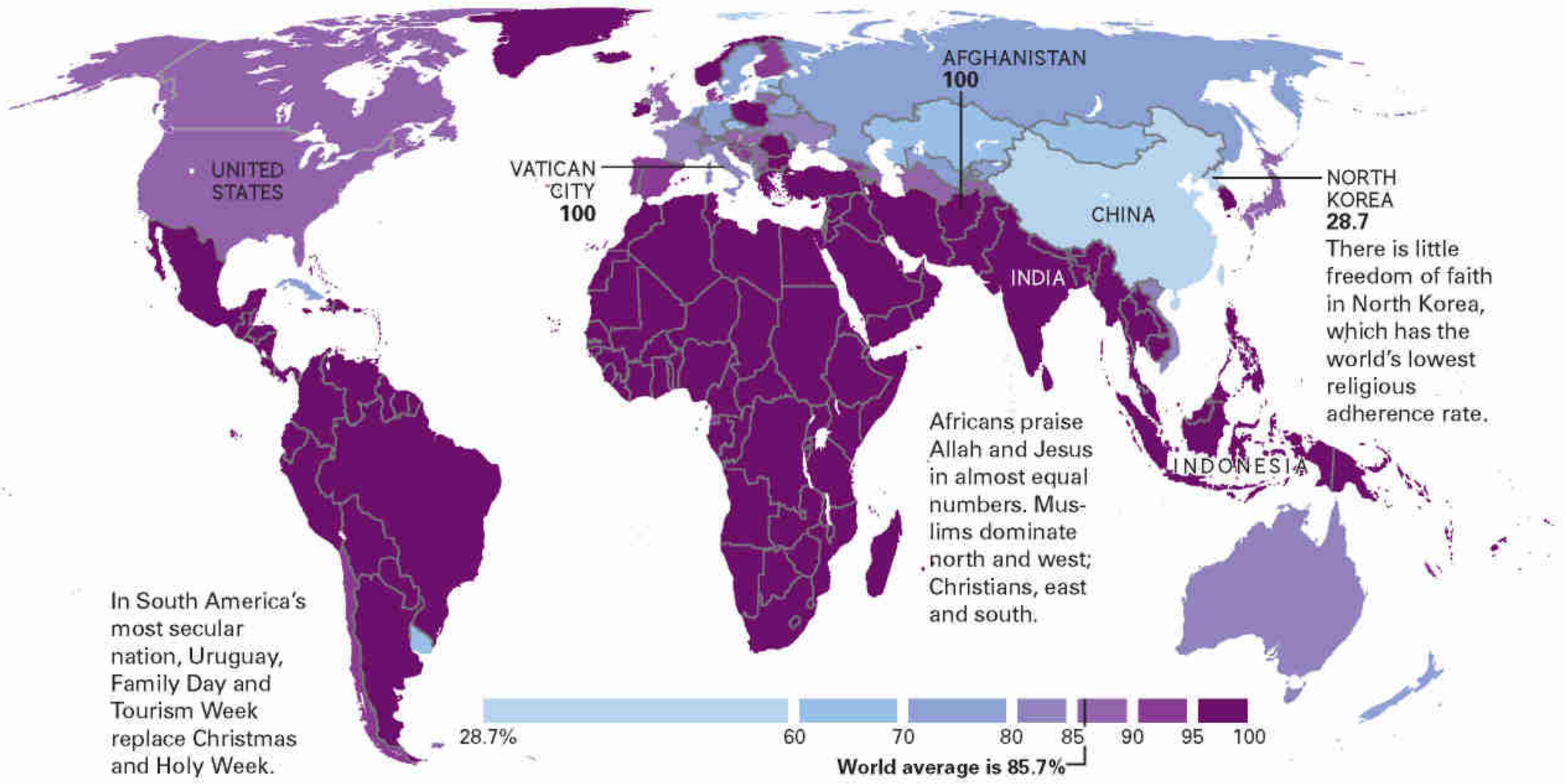


States of Faith

In the 20th century, seismic political forces altered the geography of religion when communist regimes declared millions of new atheists, and Europe's Jews were dispersed or killed. Now the ground shifts again: Christianity is on the rise in Africa, China, and Russia, while Islam grows in Europe. —*Shelley Sperry*

RELIGIOUS FOLLOWERS *by percentage of population, 2005*

Believers outnumber nonbelievers—counted here as declared atheists and nonreligious—almost everywhere.



RELIGIOUS AFFILIATION *by percentage of population, 2005*

In each of the world's four most populous countries, a different creed prevails.

	World	China	India	United States	Indonesia
Christians	**33**	8	6	**82**	13
Muslims	21	2	14	2	**77**
Nonbelievers	14	**50**	1	12	2
Hindus	13		**73**	1	3
Other	12	32	6	1	4
Buddhists	6	9	1	1	1
Jews				2	

NOTE: Percentages are rounded to the nearest whole number; numbers may not total 100. Values less than 0.5% are not shown.

PHOTO: REBECCA HALE, NGS STAFF. SOURCE: WORLD CHRISTIAN DATABASE. NGM MAPS



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Dutch height is out of sight. At 6′9.9″, Gabor Fluit dwarfs his 5′1.4″ Vietnamese wife, Suong.

Dutch Masters

A century ago, Americans were standing taller than Europeans. But today they look up to Norwegians, Danes, Swedes, Czechs, Belgians, Germans, and the Dutch, who now lead the pack. In a study published in *Social Science Quarterly,* University of Munich economist John Komlos reports average American height began to level off in the 1950s while Europe saw a steady spurt. He excluded U.S. Asians and Hispanics and anyone born outside the country.

Komlos's explanation: Europe's universal health care system. Height stems from genetics, diet, and health; good prenatal care and nutrition in early childhood yields taller, healthier adults. "Environment can cause differences of five or six inches," says Ohio State University economist Richard Steckel. "That's huge."

UNICEF puts the Netherlands at the top for child well-being among 21 wealthy nations. The U.S. ranked in the bottom third. Does this mean the Dutch can keep growing forever? "There's an upper bound," Komlos says. "I suspect the Dutch have reached it." *—Andrew Curry*

AVERAGE MAN'S HEIGHT

- **Netherlands, born in 1910:** 5′7.7″ **1976:** 6′0.4″
- **U.S., born in 1910:** 5′8.1″ **1975:** 5′10.5″

PHOTO: KRIS PANNECOUCKE, AURORA PHOTOS

Men who will become a vice president this year: 13,442

Who will retire before age 60: 940

And reconnect with their younger brother: 83

While drifting down the Amazon: 1

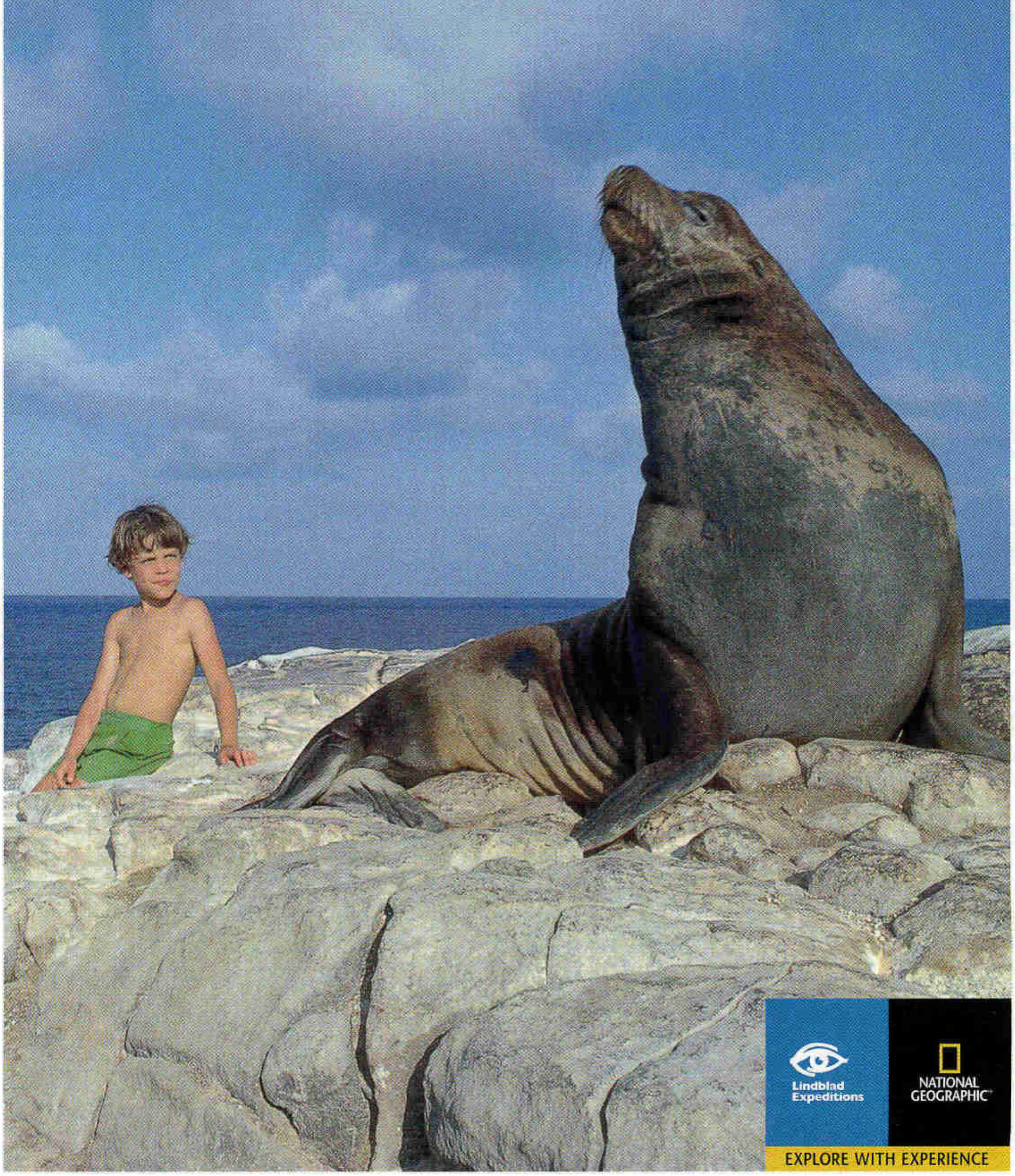
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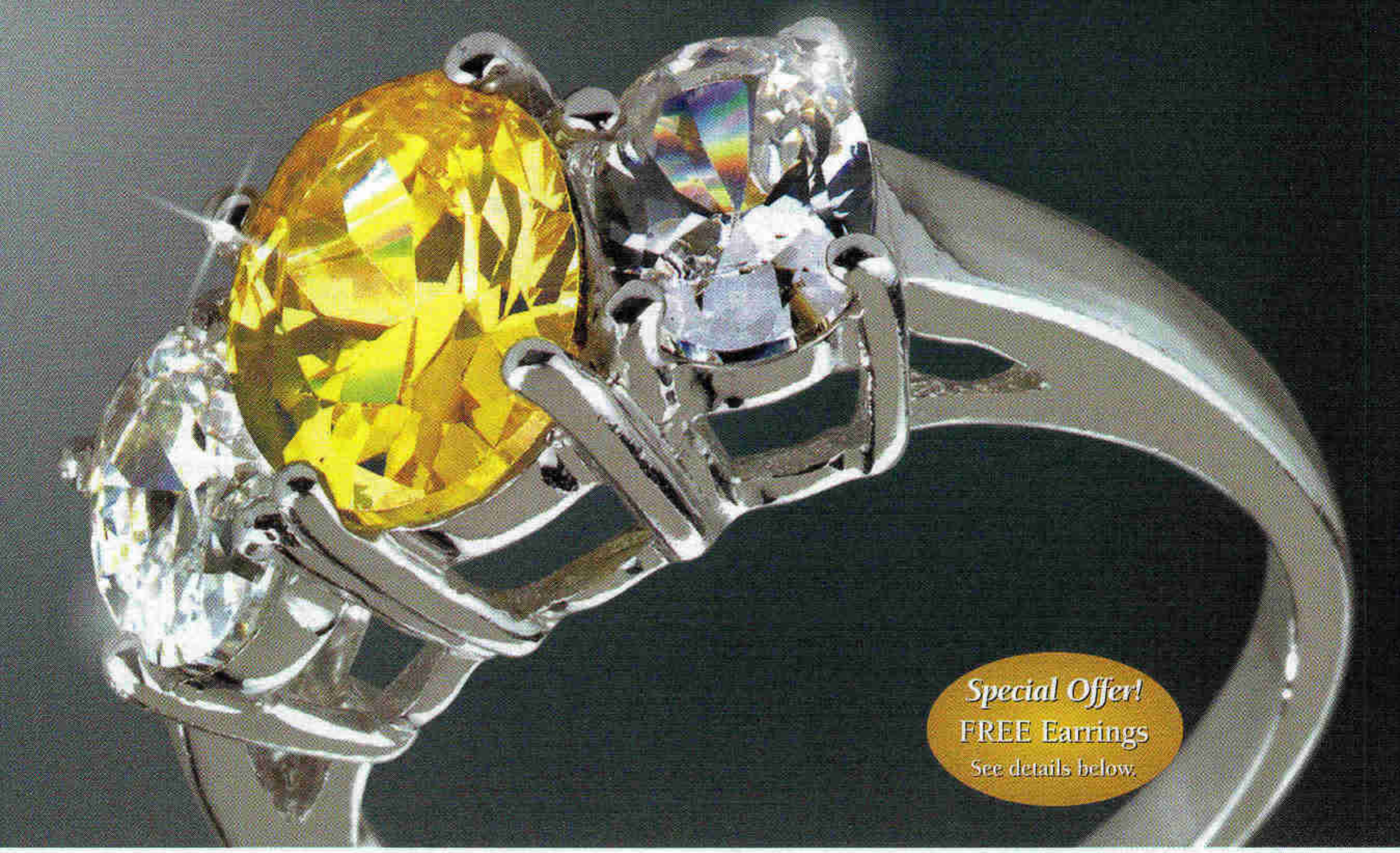


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My 5th generation Belgian gem broker specializes in finding colored diamonds with a certain size, shape, color and clarity—he doesn't trade in what is available on the local market. During our visit, he proudly displayed a brilliant round-cut Canary diamond, explaining that natural yellow color diamonds are 10,000 times more rare than their brilliant white, colorless counterparts. He said this fine Canary Yellow gemstone, framed by two white diamonds, should retail for a minimum of $10,000. As my broker admired this treasure, I decided now was the time for a little amusement.

As he glanced away, I placed a similarly colored lab-created yellow Diamond*Aura* ring next to the natural mined diamond. My broker thought he was seeing double. After close examination he was astonished—the faultless, lab-created oval-cut Diamond*Aura* was so visually similar in almost every way! He started to wonder about the future of the diamond business.

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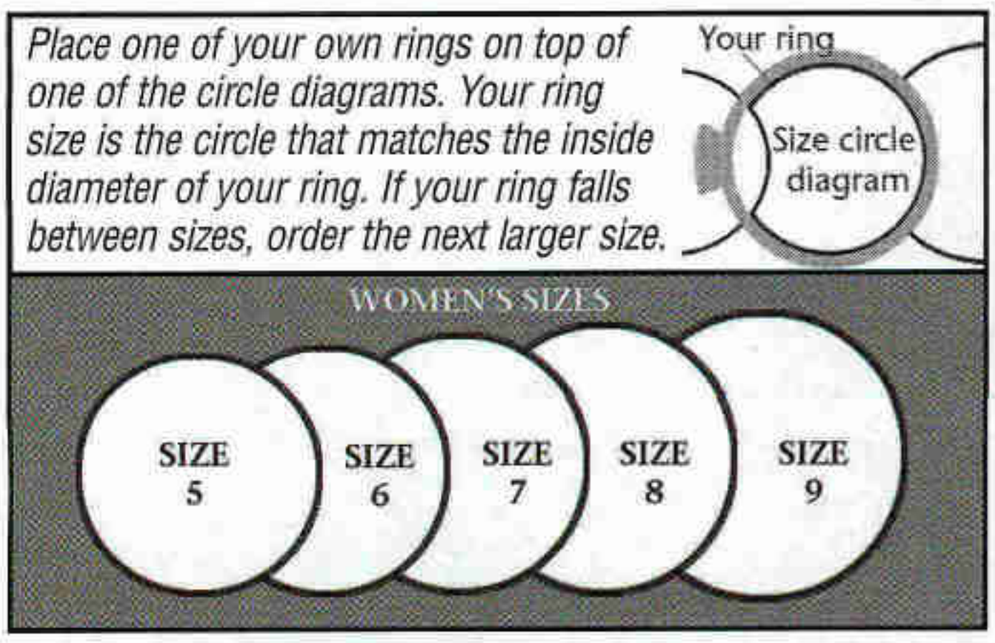
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The mysterious royal skull from tomb KV55 goes for a scan.

NG GRANTEE **Mum's the Word** In 1907 archaeologists exploring the Valley of the Kings—the great New Kingdom cemetery of Egyptian royalty—discovered a mummy badly damaged by water along with a puzzling array of funerary treasures in a tomb from about 1330 B.C. The identity of the deceased has been debated ever since. Now, a CT scan done as part of the Egyptian Mummy Project by Zahi Hawass, Egypt's chief archaeologist, has revealed some astonishing evidence. The modest tomb known as KV55 held a gilded wooden coffin with royal titles. The names on the coffin had been chiseled out and its golden face partly ripped off. Who could have provoked such vandalism? The heretic pharaoh Akhenaten, King Tut's father or brother, is one candidate. Two of the tomb's four "magic bricks," the traditional protection against evil, clearly bore his name. But the chamber also held artifacts belonging to King Amenhotep III, two queens, a princess, even Tut himself.

The CT images confirm well-known similarities between the KV55 remains and Tut (right) but offer a new twist: The bones belonged to someone perhaps as old as 60. This might fit an obscure king named Smenkhkare, who ruled briefly before Tut. Akhenaten, who lived at least to middle age, remains a possibility. Future DNA tests could add new evidence to solve this very, very cold case. *—A. R. Williams*







CLOSE RESEMBLANCE
CT images of the KV55 skull (middle) and King Tut's mummy (above) reveal distinctive egg-shaped heads.

PHOTOS: JOHN HAZARD, NATIONAL GEOGRAPHIC TELEVISION/SIEMENS (TOP); BRANDO QUILICI, NATIONAL GEOGRAPHIC TELEVISION/SIEMENS

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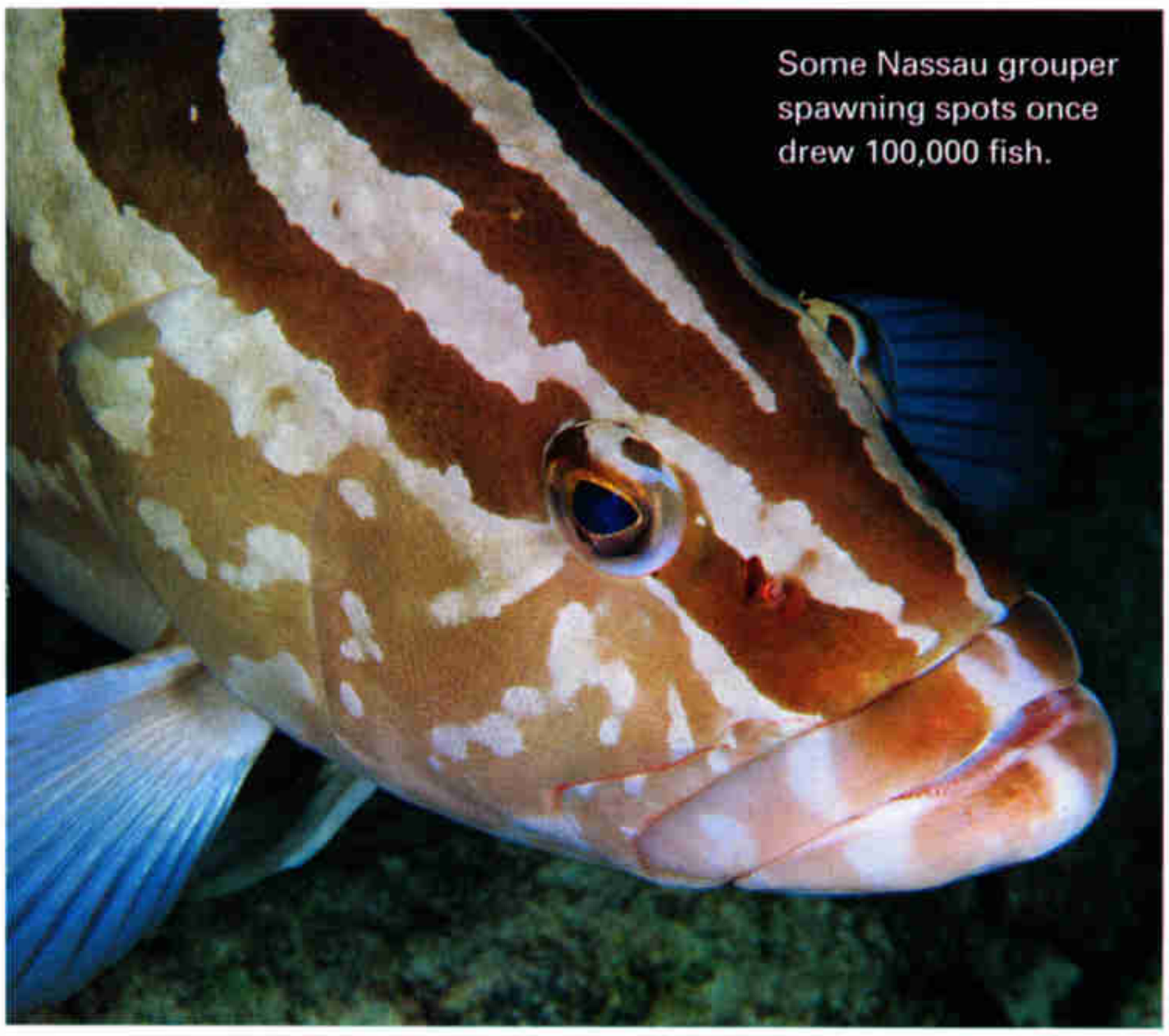
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Some Nassau grouper spawning spots once drew 100,000 fish.

Groupers in Trouble

Nassau groupers are solitary fish—usually. But each winter, around full moons at about a dozen spots in the western Atlantic, they gather to spawn. Spawning areas once teemed with tens of thousands. Then the aggregations of fish were met by aggregations of fishermen. Now the sites draw far fewer groupers; some none at all. Marine ecologist Enric Sala, a National Geographic emerging explorer, has seen populations plummet. His solution is a moratorium on fishing: If the harvest continues, "spawning will stop within a decade and the grouper will go extinct."

—Margaret G. Zackowitz

Sea Saver Read about Enric Sala's efforts at **nationalgeographic.com/emerging/esala.html.**

PHOTO: BRIAN SKERRY, NATIONAL GEOGRAPHIC IMAGE COLLECTION

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CONSERVATION

Merry Recycling Each January, the fish of Lake Havasu get a belated Christmas present: 400 or so used Yule trees, each stripped of ornaments, tied to a concrete block, and dumped in the water. Sounds like a gift from the Grinch. But if these fish could write thank-you notes, they would. The man-made desert lake, located in Arizona and California, has a barren floor; the trees form a reef to protect young bass, bluegills, and more. The cement overshoes keep trees from bobbing up and posing a risk to recreational boaters. Havasu's anglers today catch more fish than in the past. Divers enjoy the novel sight—they tell program manager Kirk Koch that the needles and algae look like "a big green glob." Within a decade, most of a tree will decompose into the muck.

The Lake Havasu project is one of the more inventive tree-repurposing efforts. More typically, trees are fed into chippers, creating mulch for trails or gardens. The group Earth 911 counts 3,985 recycling projects in the U.S., up from 3,776 in 2003. But you do need to live nearby to take part. Keith Lovell, a coastal scientist, runs a Louisiana program that uses trees to fight erosion. Once he got a call from a potential donor. "What parish do you live in?" Lovell asked. The answer: New York City. *—Marc Silver*

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■ **Wetland preserver** In southern Louisiana's coastal marshes, used and unsold trees are mashed into four-foot-tall wooden cribs. As water washes in, sediment builds up behind the cribs, eventually creating new land that helps build up the eroding shore. Estimated trees donated over 16 years: 1.5 million.

■ **Fuel source** In the small town of Tomahawk, Wisconsin, Packaging Corporation of America does its part to keep trees out of the landfill by burning about 500 a year. The steam powers the paper mill for ten minutes.

■ **Nest holder** Bird guano killed vegetation on Baker Lake Island in Cook County, Illinois. So each year, volunteers cart some 100 trees over ice (by snowmobile) or water (if the lake thaws early). Secured on foot-tall steel pipes, the trees harbor nesting herons and egrets.

Tossing Christmas trees into landfills is a little bit naughty. Turning them into mulch is much nicer.



PHOTO: REBECCA HALE, NGS STAFF

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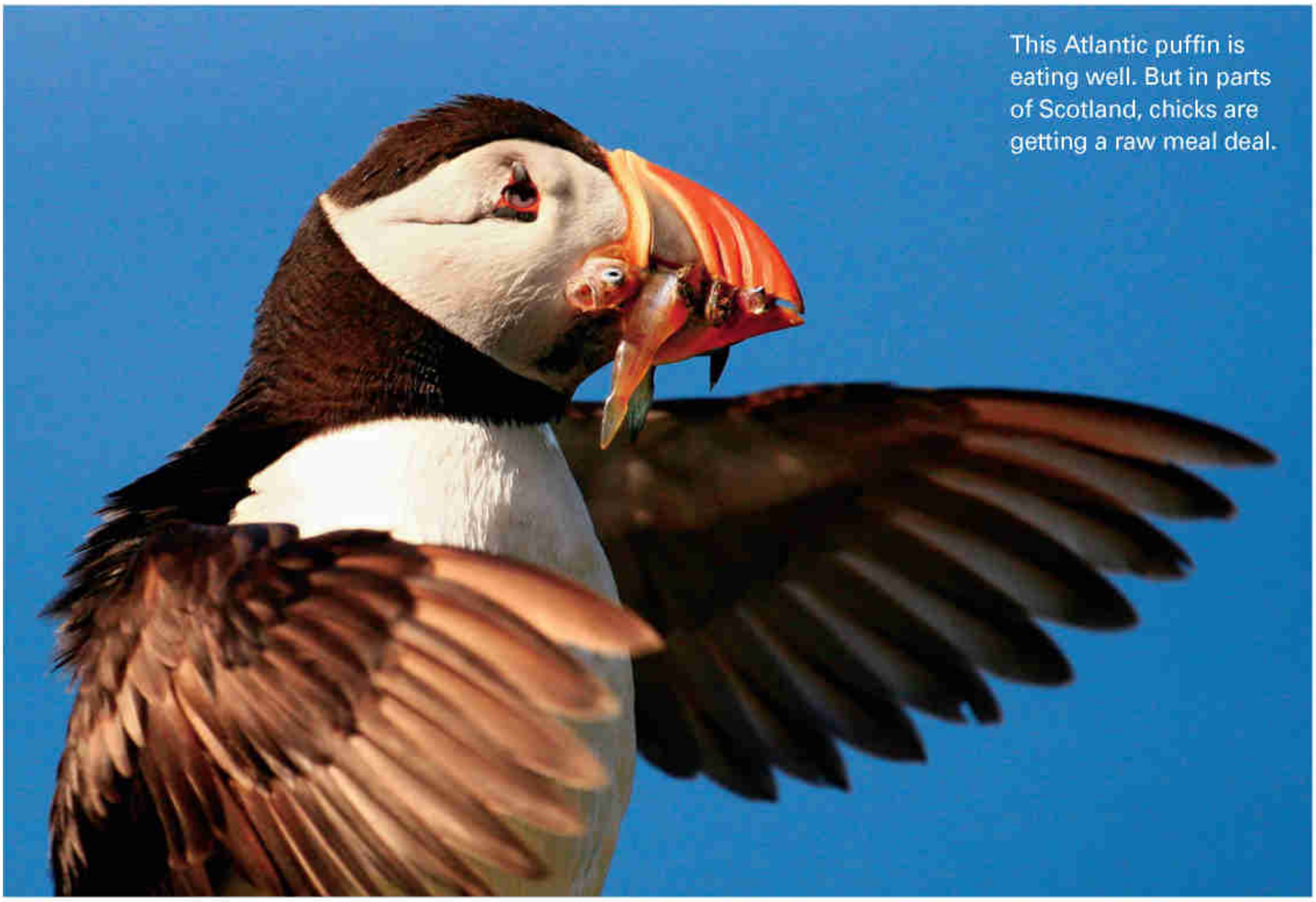


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Deadly New Diet Puffin chicks are starving on the remote Scottish islands in the St. Kilda archipelago, and the culprit may be global warming. Adult birds traditionally dive for tiny sand lance to feed their young. But snake pipefish appear to be proliferating in the area, and parents target these fish instead. Bad idea: Pipefish are longer, bonier, and harder to swallow and digest. It's not yet known if sand lance numbers have declined near St. Kilda. But on Scotland's east coast, a drop in the sand lance population has been linked to rising sea temperatures.

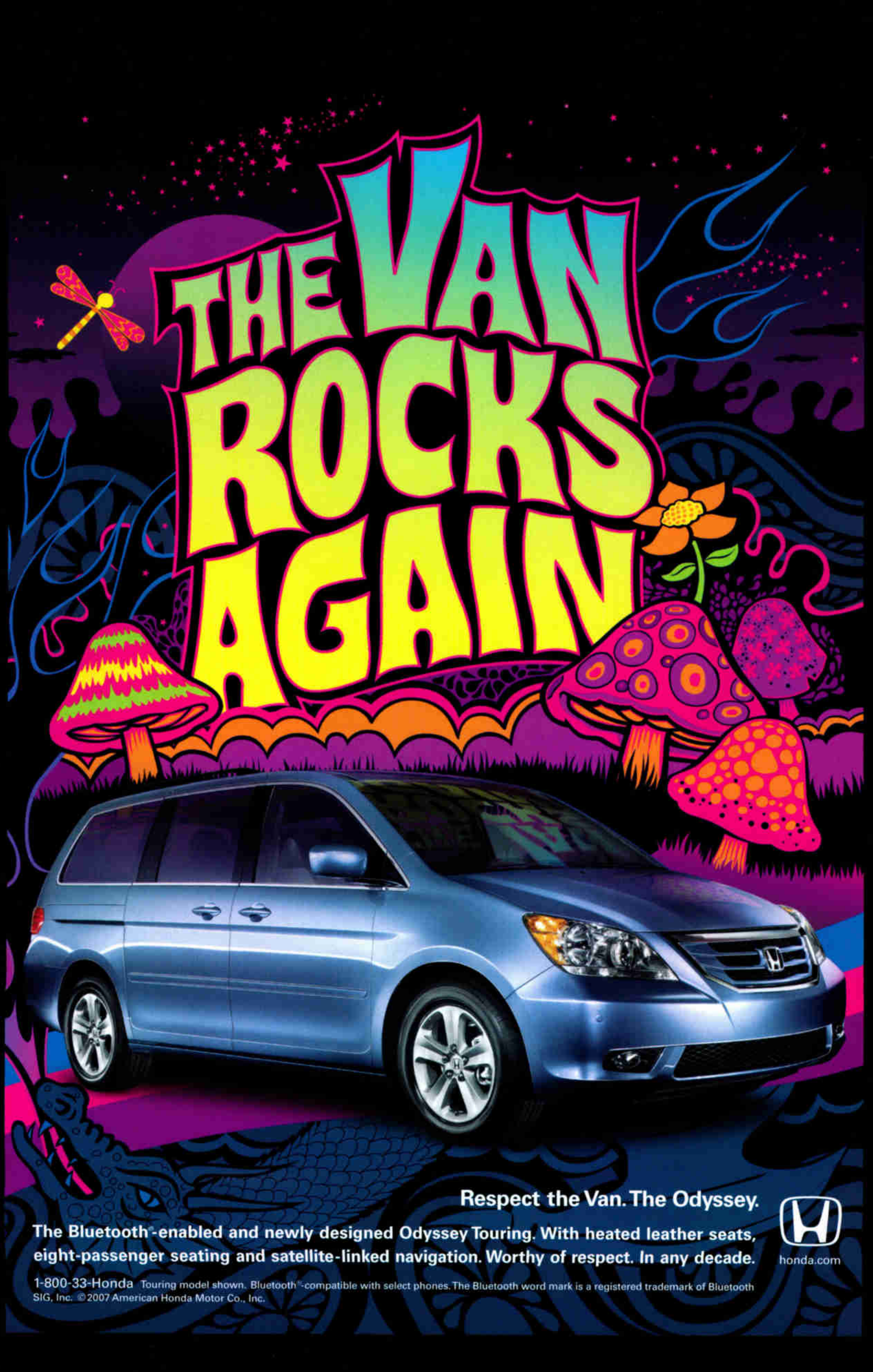
The change in diet has taken a toll on the 140,000 pairs in Scotland's largest colony of Atlantic puffins. In the past, eggs had about a 70 percent success rate: That's how many chicks (known as pufflings) grew to emerge from burrows and fly off. The rate fell to 26 percent in 2005; this year, it was 40 percent. Surviving pufflings were underweight and malnourished. "In burrows, you find piles of regurgitated, rotting snake pipefish and dead chicks, indicating they hatched OK but have essentially been starving," says Richard Luxmoore, head of nature conservation for the National Trust for Scotland. If the trend continues, the puffin count is sure to decline. *—Diane Cole*



MAKE WAY FOR MAINE'S PUFFLINGS

A century ago, overhunting wiped out most Atlantic puffins off Maine's coast. Now some 700 nesting pairs thrive on four islands, thanks to the National Audubon Society's Project Puffin. It brought eggs from Newfoundland, hand-reared chicks, and used decoys to lure them back as adults. Volunteers help too, patroling to scare off predatory gulls.

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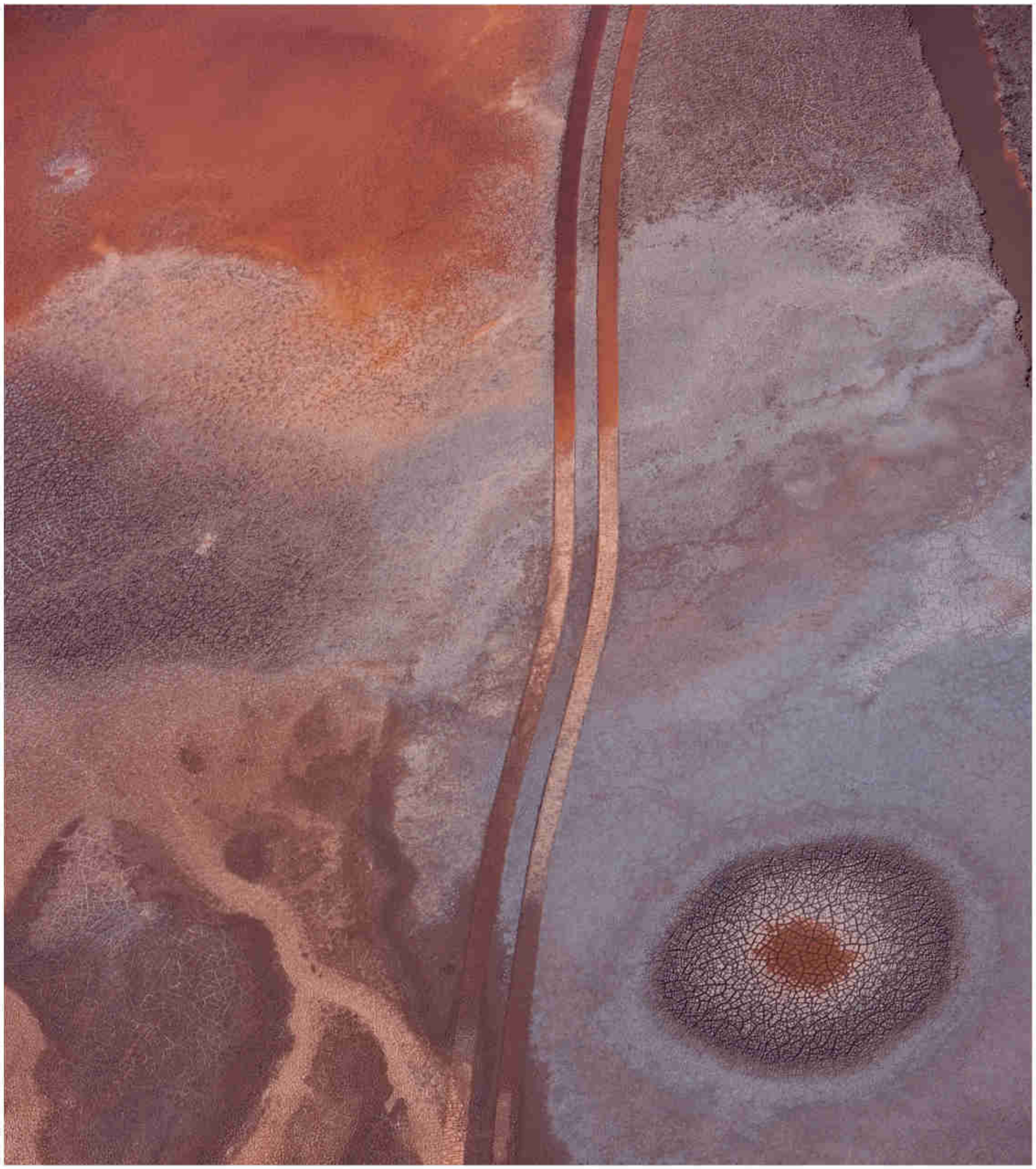
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WHERE IN THE WORLD?



Residue from an aluminum oxide refinery dries and cracks. Red indicates iron oxide; white is aluminum oxide and sodium carbonate.

Earth Work Industrial waste has its uses. Take "red mud," the thick, alkaline residue that aluminum oxide refineries produce. Excavators on pontoons carve tracks across vast containment ponds—such as this one in Gramercy, Louisiana—harvesting mud for civil projects like levees and landfill cover. But Gregory Lowry, an environmental engineer from Carnegie Mellon University, proposes another use: parkland. By adding acidic fly ash, an industrial waste, he's been able to neutralize red mud enough to support Bermuda grass and bitterweed. "It's a land-use issue," he says. "If you can grow plants, you can reclaim the land." *—Oliver Uberti*

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ARCHAEOLOGY

Faux Toe To walk like a proper Egyptian, one high-born woman who lived in Thebes about 3,000 years ago may have relied on a beautifully crafted prosthesis. Her big toe had been amputated, and when her mummy was discovered a decade ago, a substitute made of wood and leather with linen lacing lay strapped to her right foot. The toe may have been only cosmetic, but scuff marks on the bottom indicate it could have been walked on. Now scientists at the KNH Centre for Biomedical Egyptology at the University of Manchester in England plan to test a replica on volunteers who have lost a big toe to see if the device allows a walk that's close to normal. Bearing 40 percent of the body's weight, the big toe is essential to a smooth stride. Replacing a lost toe would have been especially important in ancient Egypt, where people wore sandals or went barefoot. "There was no support from a stout shoe," explains Jacky Finch, the study's lead researcher. Whether the device worked or not in this life, though, it surely was meant to complete the body in the afterworld. False arms, hands, ears, noses, and even penises were added to Egyptian deceased to ensure eternal perfection. *—A. R. Williams*



ANCIENT PROSTHESES

■ **Peg leg** The oldest artificial limb, a Roman contraption from 300 B.C., was made of bronze. It was moved to London, where World War II bombs destroyed it.

■ **False eye** Found in 2006 in the eye socket of a woman who died 4,800 years ago in what is now Iran, it was made of fat and tar with gold-wire capillaries.

■ **Calf tooth** Some 3,000 years ago, an Etruscan dentist used it to replace two missing human teeth. A gold bridge held it in place.



A lifelike carving replaced a mummy's missing toe.

PHOTO: JACKY FINCH; WITH PERMISSION OF THE EGYPTIAN MUSEUM, CAIRO

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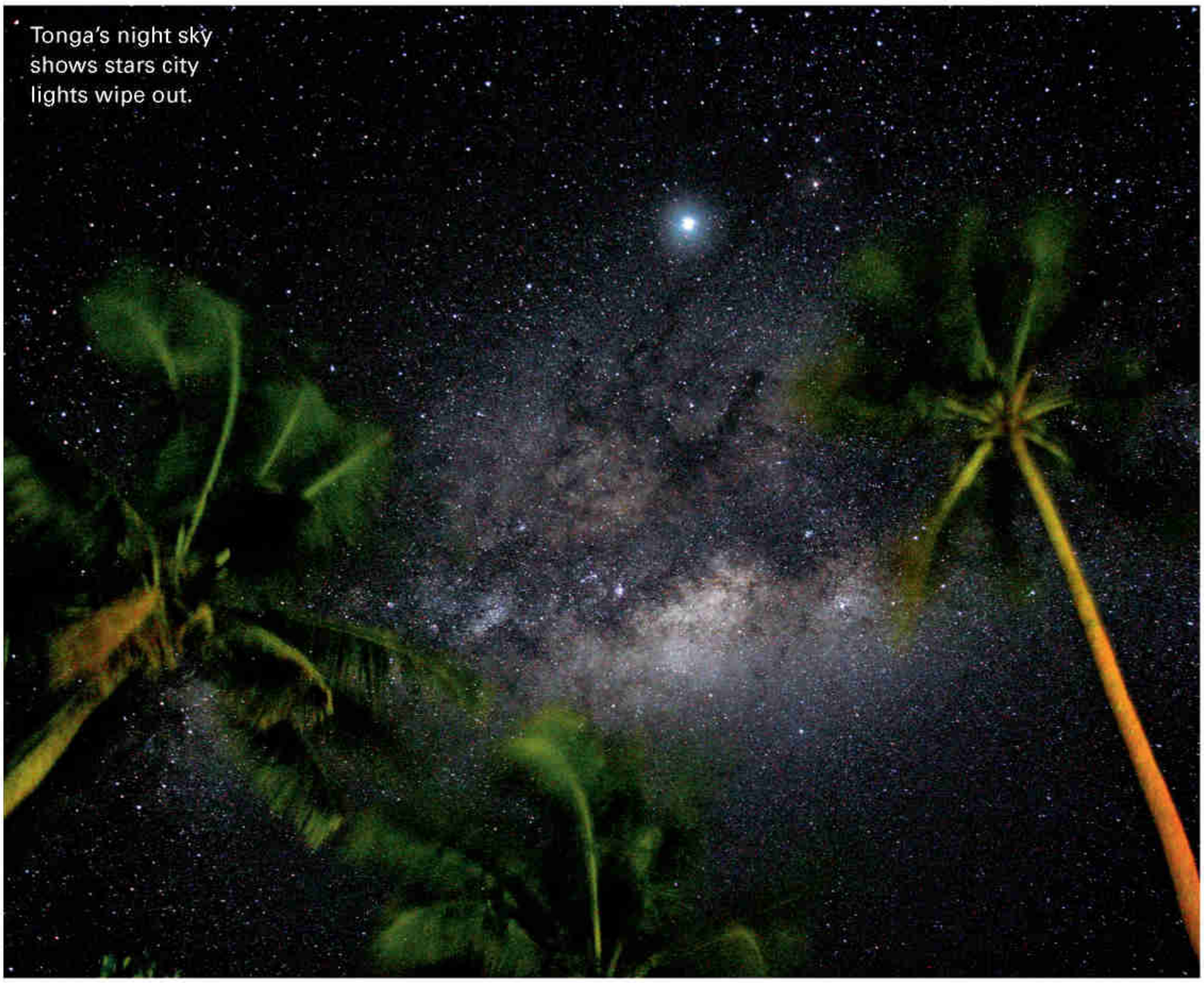


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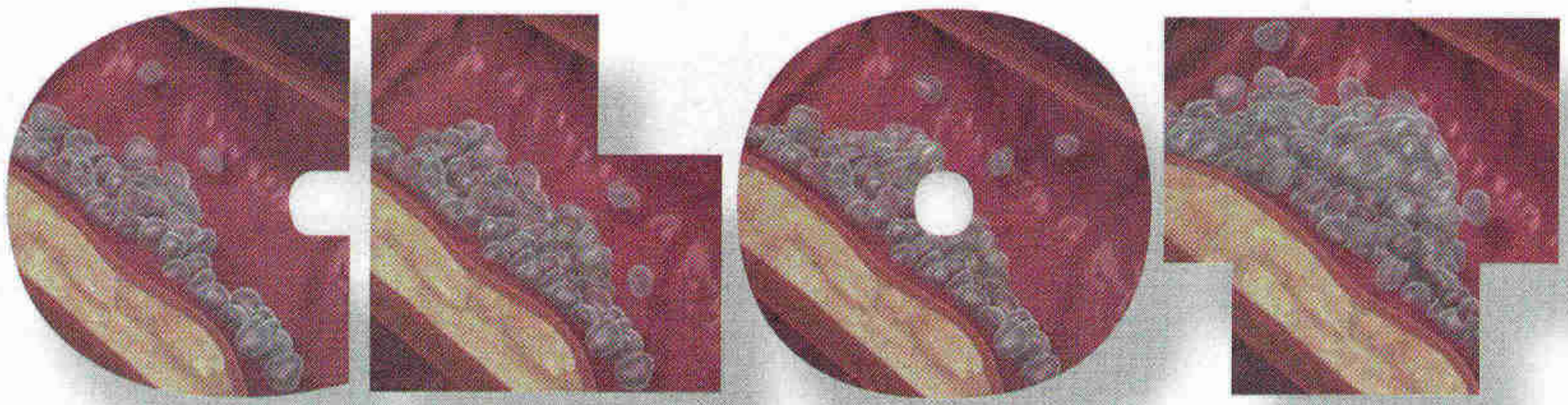
Tonga's night sky shows stars city lights wipe out.

Forces of Darkness There's a movement afoot to return to the Dark Ages—at least at night. The International Dark-Sky Association is crusading against outdoor lighting that scatters skyward, eroding our view of the cosmos. In March 2007, the group got help from the second GLOBE (Global Learning and Observations to Benefit the Environment) at Night project, which chalked up 8,491 naked-eye measurements of light pollution from 60 countries. Volunteers compared their view of the constellation Orion to online charts showing stars from magnitude 1 (very bright) to 8 (quite faint). Aegean Sea observers saw scads of stars as dim as magnitude 6; around Cleveland only the brightest stars were visible. Volunteers are also using digital sky quality meters to generate local maps. "The idea is to track changes and correlate them with other things, like population," says the National Optical Astronomy Observatory's Doug Isbell. Another goal is raising awareness to pass ordinances for cosmos-friendly lighting. Till then, casual stargazers will suffer, and many amateur and professional astronomers are making do with low-cost glass filters for telescopes that block some of the narrow wavelengths of artificial lights. *—Larry O'Hanlon*

DARKER PARKS

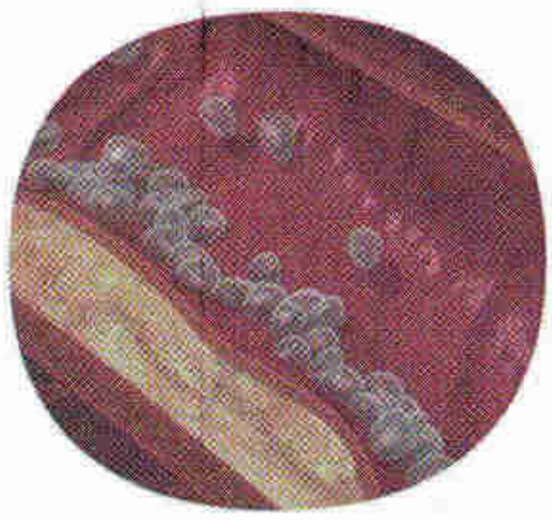
- **Big Bend** In this remote Texas spot, staff is adapting lights to keep the sky dark.
- **Death Valley** A retrofit plan will lessen light pollution (though Las Vegas twinkles 100 miles away).
- **Natural Bridges National Monument** This year, the Utah site was named the first international Dark Sky Park for its low light output.
- **Yellowstone** Work is underway to reduce lights in the Old Faithful and Mammoth areas.

PHOTO: ALLAN MORTON



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 -For patients with ST-segment elevation acute myocardial infarction, PLAVIX has been shown to reduce the rate of death from any cause and the rate of a combined endpoint of death, re-infarction or stroke. This benefit is not known to pertain to patients who receive primary angioplasty.

CONTRAINDICATIONS

The use of PLAVIX is contraindicated in the following conditions:

Hypersensitivity to the drug substance or any component of the product.

Active pathological bleeding such as peptic ulcer or intracranial hemorrhage.

WARNINGS

Thrombotic thrombocytopenic purpura (TTP):

TTP has been reported rarely following use of PLAVIX, sometimes after a short exposure (<2 weeks). TTP is a serious condition that can be fatal and requires urgent treatment including plasmapheresis (plasma exchange). It is characterized by thrombocytopenia, microangiopathic hemolytic anemia (schistocytes [fragmented RBCs] seen on peripheral smear), neurological findings, renal dysfunction, and fever. (See **ADVERSE REACTIONS**.)

PRECAUTIONS

General

PLAVIX prolongs the bleeding time and therefore should be used with caution in patients who may be at risk of increased bleeding from trauma, surgery, or other pathological conditions (particularly gastrointestinal and intraocular). If a patient is to undergo elective surgery and an antiplatelet effect is not desired, PLAVIX should be discontinued 5 days prior to surgery.

Due to the risk of bleeding and undesirable hematological effects, blood cell count determination and/or other appropriate testing should be promptly considered, whenever such suspected clinical symptoms arise during the course of treatment (see **ADVERSE REACTIONS**).

In patients with recent TIA or stroke who are at high risk for recurrent ischemic events, the combination of aspirin and PLAVIX has not been shown to be more effective than PLAVIX alone, but the combination has been shown to increase major bleeding.

GI Bleeding: In CAPRIE, PLAVIX was associated with a rate of gastrointestinal bleeding of 2.0%, vs. 2.7% on aspirin. In CURE, the incidence of major gastrointestinal bleeding was 1.3% vs 0.7% (PLAVIX + aspirin vs. placebo + aspirin, respectively). PLAVIX should be used with caution in patients who have lesions with a propensity to bleed (such as ulcers). Drugs that might induce such lesions should be used with caution in patients taking PLAVIX.

Use in Hepatically Impaired Patients: Experience is limited in patients with severe hepatic disease, who may have bleeding diatheses. PLAVIX should be used with caution in this population.

Use in Renally-impaired Patients: Experience is limited in patients with severe renal impairment. PLAVIX should be used with caution in this population.

Information for Patients

Patients should be told it may take them longer than usual to stop bleeding, that they may bruise and/or bleed more easily when they take PLAVIX or PLAVIX combined with aspirin, and that they should report any unusual bleeding to their physician. Patients should inform physicians and dentists that they are taking PLAVIX and/or any other product known to affect bleeding before any surgery is scheduled and before any new drug is taken.

Drug Interactions

Study of specific drug interactions yielded the following results:

Aspirin: Aspirin did not modify the clopidogrel-mediated inhibition of ADP-induced platelet aggregation. Concomitant administration of 500 mg of aspirin twice a day for 1 day did not significantly increase the prolongation of bleeding time induced by PLAVIX. PLAVIX potentiated the effect of aspirin on collagen-induced platelet aggregation. PLAVIX and aspirin have been administered together for up to one year.

Heparin: In a study in healthy volunteers, PLAVIX did not necessitate modification of the heparin dose or alter the effect of heparin on coagulation. Coadministration of heparin had no effect on inhibition of platelet aggregation induced by PLAVIX.

Nonsteroidal Anti-Inflammatory Drugs (NSAIDs): In healthy volunteers receiving naproxen, concomitant administration of PLAVIX was associated with increased occult gastrointestinal blood loss. NSAIDs and PLAVIX should be coadministered with caution.

Warfarin: Because of the increased risk of bleeding, the concomitant administration of warfarin with PLAVIX should be undertaken with caution. (See **PRECAUTIONS– General.**)

Other Concomitant Therapy: No clinically significant pharmacodynamic interactions were observed when PLAVIX was coadministered with **atenolol, nifedipine,** or both atenolol and nifedipine. The pharmacodynamic activity of PLAVIX was also not significantly influenced by the coadministration of **phenobarbital, cimetidine** or **estrogen.**

The pharmacokinetics of **digoxin** or **theophylline** were not modified by the coadministration of PLAVIX (clopidogrel bisulfate).

At high concentrations *in vitro*, clopidogrel inhibits P_{450} (2C9). Accordingly, PLAVIX may interfere with the metabolism of **phenytoin, tamoxifen, tolbutamide, warfarin, torsemide, fluvastatin,** and many **non-steroidal anti-inflammatory agents,** but there are no data with which to predict the magnitude of these interactions. Caution should be used when any of these drugs is coadministered with PLAVIX.

In addition to the above specific interaction studies, patients entered into clinical trials with PLAVIX received a variety of concomitant medications including **diuretics, beta-blocking agents, angiotensin converting enzyme inhibitors, calcium antagonists, cholesterol lowering agents, coronary vasodilators, antidiabetic agents** (including **insulin), thrombolytics, heparins** (unfractionated and LMWH) **GPIIb/IIIa antagonists, antiepileptic agents** and **hormone replacement therapy** without evidence of clinically significant adverse interactions.

There are no data on the concomitant use of oral anticoagulants, non-study oral anti-platelet drugs and chronic NSAIDs with clopidogrel.

Drug/Laboratory Test Interactions

None known.

Carcinogenesis, Mutagenesis, Impairment of Fertility

There was no evidence of tumorigenicity when clopidogrel was administered for 78 weeks to mice and 104 weeks to rats at dosages up to 77 mg/kg per day, which afforded plasma exposures >25 times that in humans at the recommended daily dose of 75 mg.

Clopidogrel was not genotoxic in four *in vitro* tests (Ames test, DNA-repair test in rat hepatocytes, gene mutation assay in Chinese hamster fibroblasts, and metaphase chromosome analysis of human lymphocytes) and in one *in vivo* test (micronucleus test by oral route in mice).

Clopidogrel was found to have no effect on fertility of male and female rats at oral doses up to 400 mg/kg per day (52 times the recommended human dose on a mg/m^2 basis).

Pregnancy

Pregnancy Category B. Reproduction studies performed in rats and rabbits at doses up to 500 and 300 mg/kg/day (respectively, 65 and 78 times the recommended daily human dose on a mg/m^2 basis), revealed no evidence of impaired fertility or fetotoxicity due to clopidogrel. There are, however, no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of a human response, PLAVIX should be used during pregnancy only if clearly needed.

Nursing Mothers

Studies in rats have shown that clopidogrel and/or its metabolites are excreted in the milk. It is not known whether this drug is excreted in human milk. Because many drugs are excreted in human milk and because of the potential for serious adverse reactions in nursing infants, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the nursing woman.

Pediatric Use

Safety and effectiveness in the pediatric population have not been established.

Geriatric Use

Of the total number of subjects in CAPRIE, CURE and CLARITY controlled clinical studies, approximately 50% of patients treated with PLAVIX were 65 years of age and older and 15% were 75 years and older. In COMMIT, approximately 58% of the patients treated with PLAVIX were 60 years and older, 26% of whom were 70 years and older.

The observed risk of thrombotic events with clopidogrel plus aspirin versus placebo plus aspirin by age category is provided in Figures 3 and 6 for the CURE and COMMIT trials, respectively (see **CLINICAL STUDIES**). The observed risk of bleeding events with clopidogrel plus aspirin versus placebo plus aspirin by age category is provided in Tables 5 and 6 for the CURE and COMMIT trials, respectively (see **ADVERSE REACTIONS**).

ADVERSE REACTIONS

PLAVIX has been evaluated for safety in more than 42,000 patients, including over 9,000 patients treated for 1 year or more. The clinically important adverse events observed in CAPRIE, CURE, CLARITY and COMMIT are discussed below.

The overall tolerability of PLAVIX in CAPRIE was similar to that of aspirin regardless of age, gender and race, with an approximately equal incidence (13%) of patients withdrawing from treatment because of adverse reactions.

Hemorrhagic: In CAPRIE patients receiving PLAVIX, gastrointestinal hemorrhage occurred at a rate of 2.0%, and required hospitalization in 0.7%. In patients receiving aspirin, the corresponding rates were 2.7% and 1.1%, respectively. The incidence of intracranial hemorrhage was 0.4% for PLAVIX compared to 0.5% for aspirin.

In CURE, PLAVIX use with aspirin was associated with an increase in bleeding compared to placebo with aspirin (see Table 5). There was an excess in major bleeding in patients receiving PLAVIX plus aspirin compared with placebo plus aspirin, primarily gastrointestinal and at puncture sites. The incidence of intracranial hemorrhage (0.1%), and fatal bleeding (0.2%), were the same in both groups.

The overall incidence of bleeding is described in Table 5 for patients receiving both PLAVIX and aspirin in CURE.

Table 5: CURE Incidence of bleeding complications (% patients)

Event	PLAVIX (+ aspirin)* (n=6259)	Placebo (+ aspirin)* (n=6303)	P-value
Major bleeding †	3.7 ‡	2.7 §	0.001
Life-threatening bleeding	2.2	1.8	0.13
Fatal	0.2	0.2	
5 g/dL hemoglobin drop	0.9	0.9	
Requiring surgical intervention	0.7	0.7	
Hemorrhagic strokes	0.1	0.1	
Requiring inotropes	0.5	0.5	
Requiring transfusion (≥4 units)	1.2	1.0	
Other major bleeding	1.6	1.0	0.005
Significantly disabling	0.4	0.3	
Intraocular bleeding with significant loss of vision	0.05	0.03	
Requiring 2-3 units of blood	1.3	0.9	
Minor bleeding ¶	5.1	2.4	<0.001

* Other standard therapies were used as appropriate.

† Life threatening and other major bleeding.

‡ Major bleeding event rate for PLAVIX + aspirin was dose-dependent on aspirin: <100 mg=2.6%; 100-200 mg= 3.5%; >200 mg=4.9%
Major bleeding event rates for PLAVIX + aspirin by age were: <65 years = 2.5%, ≥65 to <75 years = 4.1%, ≥75 years 5.9%

§ Major bleeding event rate for placebo + aspirin was dose-dependent on aspirin: <100 mg=2.0%; 100-200 mg= 2.3%; >200 mg=4.0%
Major bleeding event rates for placebo + aspirin by age were: <65 years = 2.1%, ≥65 to <75 years = 3.1%, ≥75 years 3.6%

¶ Led to interruption of study medication.

Ninety-two percent (92%) of the patients in the CURE study received heparin/LMWH, and the rate of bleeding in these patients was similar to the overall results.

There was no excess in major bleeds within seven days after coronary bypass graft surgery in patients who stopped therapy more than five days prior to surgery (event rate 4.4% PLAVIX + aspirin; 5.3% placebo + aspirin). In patients who remained on therapy within five days of bypass graft surgery, the event rate was 9.6% for PLAVIX + aspirin, and 6.3% for placebo + aspirin.

In CLARITY, the incidence of major bleeding (defined as intracranial bleeding or bleeding associated with a fall in hemoglobin > 5 g/dL) was similar between groups (1.3% versus 1.1% in the PLAVIX + aspirin and in the placebo + aspirin groups, respectively). This was consistent across subgroups of patients defined by baseline characteristics, and type of fibrinolytics or heparin therapy. The incidence of fatal bleeding (0.8% versus 0.6% in the PLAVIX + aspirin and in the placebo + aspirin groups, respectively) and intracranial hemorrhage (0.5% versus 0.7%, respectively) was low and similar in both groups.

The overall rate of noncerebral major bleeding or cerebral bleeding in COMMIT was low and similar in both groups as shown in Table 6 below.

Table 6: Number (%) of Patients with Bleeding Events in COMMIT

Type of bleeding	PLAVIX (+ aspirin) (N = 22961)	Placebo (+ aspirin) (N = 22891)	P-value
Major* noncerebral or cerebral bleeding**	134 (0.6%)	125 (0.5%)	0.59
Major noncerebral	82 (0.4%)	73 (0.3%)	0.48
Fatal	36 (0.2%)	37 (0.2%)	0.90
Hemorrhagic stroke	55 (0.2%)	56 (0.2%)	0.91
Fatal	39 (0.2%)	41 (0.2%)	0.81
Other noncerebral bleeding (non-major)	831 (3.6%)	721 (3.1%)	0.005
Any noncerebral bleeding	896 (3.9%)	777 (3.4%)	0.004

* Major bleeds are cerebral bleeds or non-cerebral bleeds thought to have caused death or that required transfusion.

** The relative rate of major noncerebral or cerebral bleeding was independent of age. Event rates for PLAVIX + aspirin by age were: <60 years = 0.3%, ≥60 to <70 years = 0.7%, ≥70 years 0.8%. Event rates for placebo + aspirin by age were: <60 years = 0.4%, ≥60 to <70 years = 0.6%, ≥70 years 0.7%.

Adverse events occurring in ≥2.5% of patients on PLAVIX in the CAPRIE controlled clinical trial are shown below regardless of relationship to PLAVIX. The median duration of therapy was 20 months, with a maximum of 3 years.

Table 7: Adverse Events Occurring in ≥2.5% of PLAVIX Patients in CAPRIE

	% Incidence (% Discontinuation)	
Body System **Event**	**PLAVIX [n=9599]**	**Aspirin [n=9586]**
Body as a Whole – general disorders		
Chest Pain	8.3 (0.2)	8.3 (0.3)
Accidental/Inflicted Injury	7.9 (0.1)	7.3 (0.1)
Influenza-like symptoms	7.5 (<0.1)	7.0 (<0.1)
Pain	6.4 (0.1)	6.3 (0.1)
Fatigue	3.3 (0.1)	3.4 (0.1)
Cardiovascular disorders, general		
Edema	4.1 (<0.1)	4.5 (<0.1)
Hypertension	4.3 (<0.1)	5.1 (<0.1)
Central & peripheral nervous system disorders		
Headache	7.6 (0.3)	7.2 (0.2)
Dizziness	6.2 (0.2)	6.7 (0.3)
Gastrointestinal system disorders		
Any event	27.1(3.2)	29.8 (4.0)
Abdominal pain	5.6 (0.7)	7.1 (1.0)
Dyspepsia	5.2 (0.6)	6.1 (0.7)
Diarrhea	4.5 (0.4)	3.4 (0.3)
Nausea	3.4 (0.5)	3.8 (0.4)
Metabolic & nutritional disorders		
Hypercholesterolemia	4.0 (0)	4.4 (<0.1)
Musculo-skeletal system disorders		
Arthralgia	6.3 (0.1)	6.2 (0.1)
Back Pain	5.8 (0.1)	5.3 (<0.1)
Platelet, bleeding, & clotting disorders		
Purpura/Bruise	5.3 (0.3)	3.7 (0.1)
Epistaxis	2.9 (0.2)	2.5 (0.1)
Psychiatric disorders		
Depression	3.6 (0.1)	3.9 (0.2)
Respiratory system disorders		
Upper resp tract infection	8.7 (<0.1)	8.3 (<0.1)
Dyspnea	4.5 (0.1)	4.7 (0.1)
Rhinitis	4.2 (0.1)	4.2 (<0.1)
Bronchitis	3.7 (0.1)	3.7 (0)
Coughing	3.1 (<0.1)	2.7(<0.1)
Skin & appendage disorders		
Any event	15.8 (1.5)	13.1 (0.8)
Rash	4.2 (0.5)	3.5 (0.2)
Pruritus	3.3 (0.3)	1.6 (0.1)
Urinary system disorders		
Urinary tract infection	3.1 (0)	3.5 (0.1)

No additional clinically relevant events to those observed in CAPRIE with a frequency ≥2.5%, have been reported during the CURE and CLARITY controlled studies. COMMIT collected only limited safety data.

Other adverse experiences of potential importance occurring in 1% to 2.5% of patients receiving PLAVIX (clopidogrel bisulfate) in the controlled clinical trials are listed below regardless of relationship to PLAVIX. In general, the incidence of these events was similar to that in patients receiving aspirin (in CAPRIE) or placebo + aspirin (in the other clinical trials).

Autonomic Nervous System Disorders: Syncope, Palpitation. *Body as a Whole-general disorders:* Asthenia, Fever, Hernia. *Cardiovascular disorders:* Cardiac failure. *Central and peripheral nervous system disorders:* Cramps legs, Hypoaesthesia, Neuralgia, Paraesthesia, Vertigo. *Gastrointestinal system disorders:* Constipation, Vomiting. *Heart rate and rhythm disorders:* Fibrillation atrial. *Liver and biliary system disorders:* Hepatic enzymes increased. *Metabolic and nutritional disorders:* Gout, hyperuricemia, non-protein nitrogen (NPN) increased. *Musculo-skeletal system disorders:* Arthritis, Arthrosis. *Platelet, bleeding & clotting disorders:* GI hemorrhage, hematoma, platelets decreased. *Psychiatric disorders:* Anxiety, Insomnia. *Red blood cell disorders:* Anemia. *Respiratory system disorders:* Pneumonia, Sinusitis. *Skin and appendage disorders:* Eczema, Skin ulceration. *Urinary system disorders:* Cystitis. *Vision disorders:* Cataract, Conjunctivitis.

Other potentially serious adverse events which may be of clinical interest but were rarely reported (<1%) in patients who received PLAVIX in the controlled clinical trials are listed below regardless of relationship to PLAVIX. In general, the incidence of these events was similar to that in patients receiving aspirin (in the other clinical trials) .

Body as a whole: Allergic reaction, necrosis ischemic. *Cardiovascular disorders:* Edema generalized. *Gastrointestinal system disorders:* Peptic, gastric or duodenal ulcer, gastritis, gastric ulcer perforated, gastritis hemorrhagic, upper GI ulcer hemorrhagic. *Liver and Biliary system disorders:* Bilirubinemia, hepatitis infectious, liver fatty. *Platelet, bleeding and clotting disorders:* hemarthrosis, hematuria, hemoptysis, hemorrhage intracranial, hemorrhage retroperitoneal, hemorrhage of operative wound, ocular hemorrhage, pulmonary hemorrhage, purpura allergic, thrombocytopenia. *Red blood cell disorders:* Anemia aplastic, anemia hypochromic. *Reproductive disorders, female:* Menorrhagia. *Respiratory system disorders:* Hemothorax. *Skin and appendage disorders:* Bullous eruption, rash erythematous, rash maculopapular, urticaria. *Urinary system disorders:* Abnormal renal function, acute renal failure. *White cell and reticuloendothelial system disorders:* Agranulocytosis, granulocytopenia, leukemia, leukopenia, neutropenia.

Postmarketing Experience

The following events have been reported spontaneously from worldwide postmarketing experience:

- *Body as a whole:*
 -hypersensitivity reactions, anaphylactoid reactions, serum sickness
- *Central and Peripheral Nervous System disorders:*
 -confusion, hallucinations, taste disorders
- *Hepato-biliary disorders:*
 -abnormal liver function test, hepatitis (non-infectious), acute liver failure
- *Platelet, Bleeding and Clotting disorders:*
 -cases of bleeding with fatal outcome (especially intracranial, gastrointestinal and retroperitoneal hemorrhage)
 -thrombotic thrombocytopenic purpura (TTP) – some cases with fatal outcome- (see **WARNINGS**).
 -agranulocytosis, aplastic anemia/pancytopenia
 -conjunctival, ocular and retinal bleeding
- *Respiratory, thoracic and mediastinal disorders:*
 -bronchospasm, interstitial pneumonitis
- *Skin and subcutaneous tissue disorders:*
 -angioedema, erythema multiforme, Stevens-Johnson syndrome, toxic epidermal necrolysis, lichen planus
- *Renal and urinary disorders:*
 - glomerulopathy, increased creatinine levels
- *Vascular disorders:*
 - vasculitis, hypotension
- *Gastrointestinal disorders:*
 - colitis (including ulcerative or lymphocytic colitis), pancreatitis, stomatitis
- *Musculoskeletal, connective tissue and bone disorders:*
 - myalgia

OVERDOSAGE

Overdose following clopidogrel administration may lead to prolonged bleeding time and subsequent bleeding complications. A single oral dose of clopidogrel at 1500 or 2000 mg/kg was lethal to mice and to rats and at 3000 mg/kg to baboons. Symptoms of acute toxicity were vomiting (in baboons), prostration, difficult breathing, and gastrointestinal hemorrhage in all species.

Recommendations About Specific Treatment:

Based on biological plausibility, platelet transfusion may be appropriate to reverse the pharmacological effects of PLAVIX if quick reversal is required.

DOSAGE AND ADMINISTRATION

Recent MI, Recent Stroke, or Established Peripheral Arterial Disease

The recommended daily dose of PLAVIX is 75 mg once daily.

Acute Coronary Syndrome

For patients with non-ST-segment elevation acute coronary syndrome (unstable angina/non-Q-wave MI), PLAVIX should be initiated with a single 300 mg loading dose and then continued at 75 mg once daily. Aspirin (75 mg-325 mg once daily) should be initiated and continued in combination with PLAVIX. In CURE, most patients with Acute Coronary Syndrome also received heparin acutely (see **CLINICAL STUDIES).**

For patients with ST-segment elevation acute myocardial infarction, the recommended dose of PLAVIX is 75 mg once daily, administered in combination with aspirin, with or without thrombolytics. PLAVIX may be initiated with or without a loading dose (300 mg was used in CLARITY; see **CLINICAL STUDIES**).

PLAVIX can be administered with or without food.

No dosage adjustment is necessary for elderly patients or patients with renal disease. (See **Clinical Pharmacology: Special Populations.**)

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Brief Summary of Prescribing Information Revised February 2007

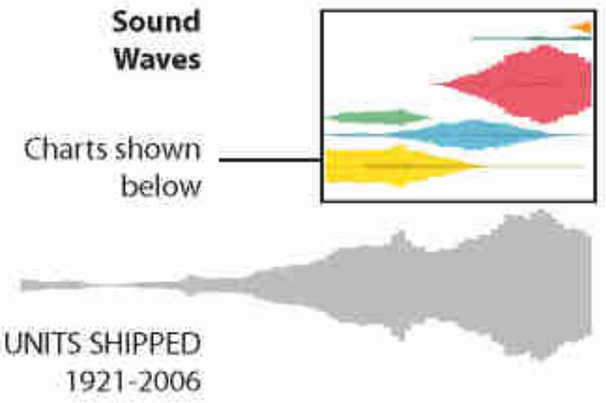
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TECHNOLOGY

Music Minus CDs This year, iTunes sold the three billionth digital song of its short four-year life as an online store. That shrieking noise you hear is the sound of the music industry going "No! No! No!" For years, CDs have been a cash cow. Downloading a single song for about a dollar instead of buying an album is just not going to have the same benefit for the bottom line. "It's all about the à la carte song purchase," says digital music analyst Matt Kleinschmit. And that's mainly because of the iPod. When Apple's digital music device took off, CDs started to lose their luster.

Despite declining sales, the disc isn't about to fade out. Fans still tend to buy CDs when a favorite performer releases an album. But for new artists, the digital option is heaven-sent. "A kid in Des Moines can have the same distribution power as the largest corporation," says Jeff Price, CEO of TuneCore, which delivers music to online stores. Who needs a record label when a catchy song and a YouTube video can make you a star? —*Marc Silver*





In 2006, 11.5 billion dollars' worth of music was tallied—from LPs for old schoolers to digital downloads.

UNITS SHIPPED

In millions of dollars

Technology drives the market. Hello, Walkman. So long, 8-tracks and albums. Hello, CDs. Adios, cassette tapes.

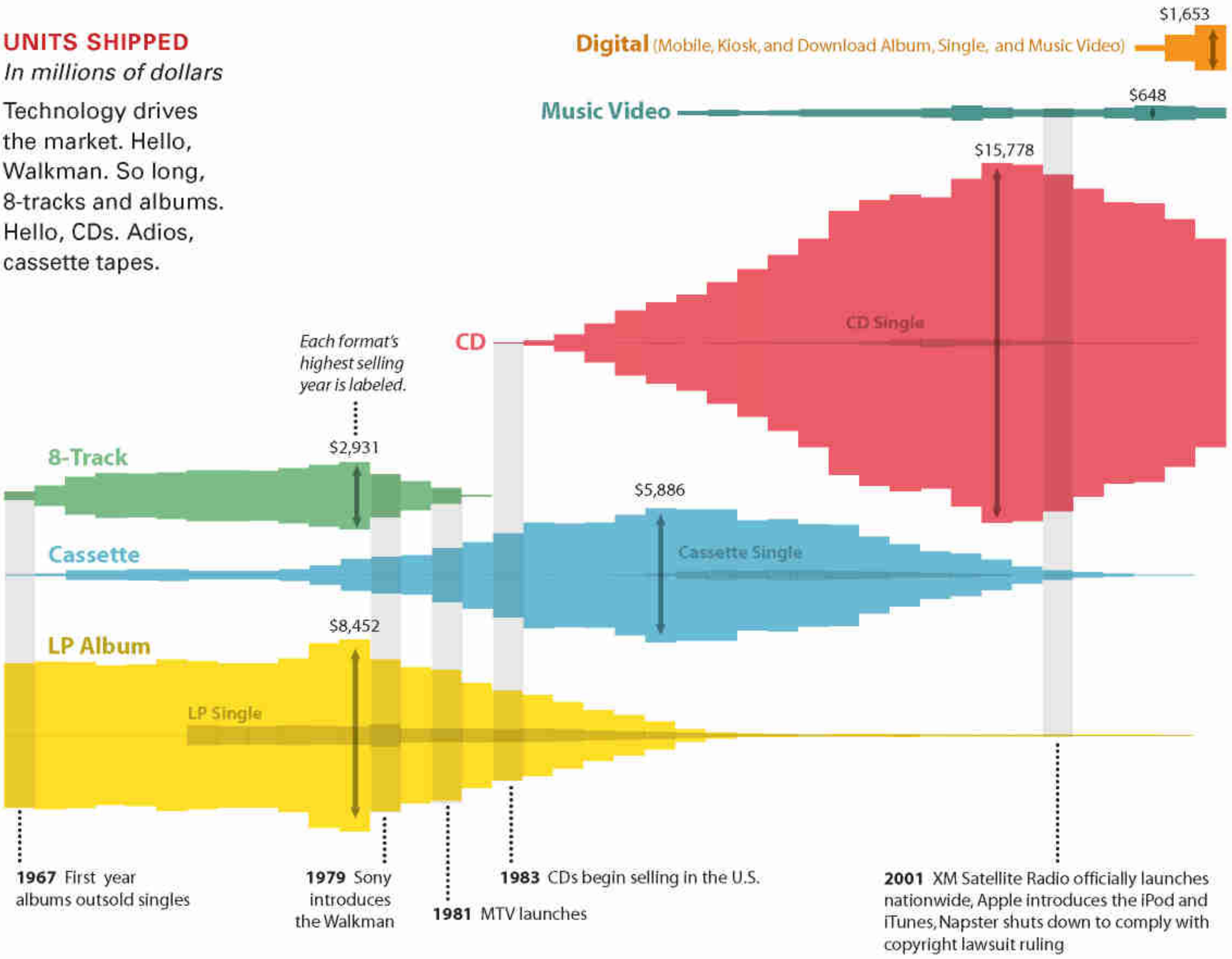


PHOTO: NATIONAL GEOGRAPHIC PHOTOGRAPHER MARK THIESSEN. ART BY JONATHAN AVERY. SOURCE: RECORDING INDUSTRY ASSOCIATION OF AMERICA

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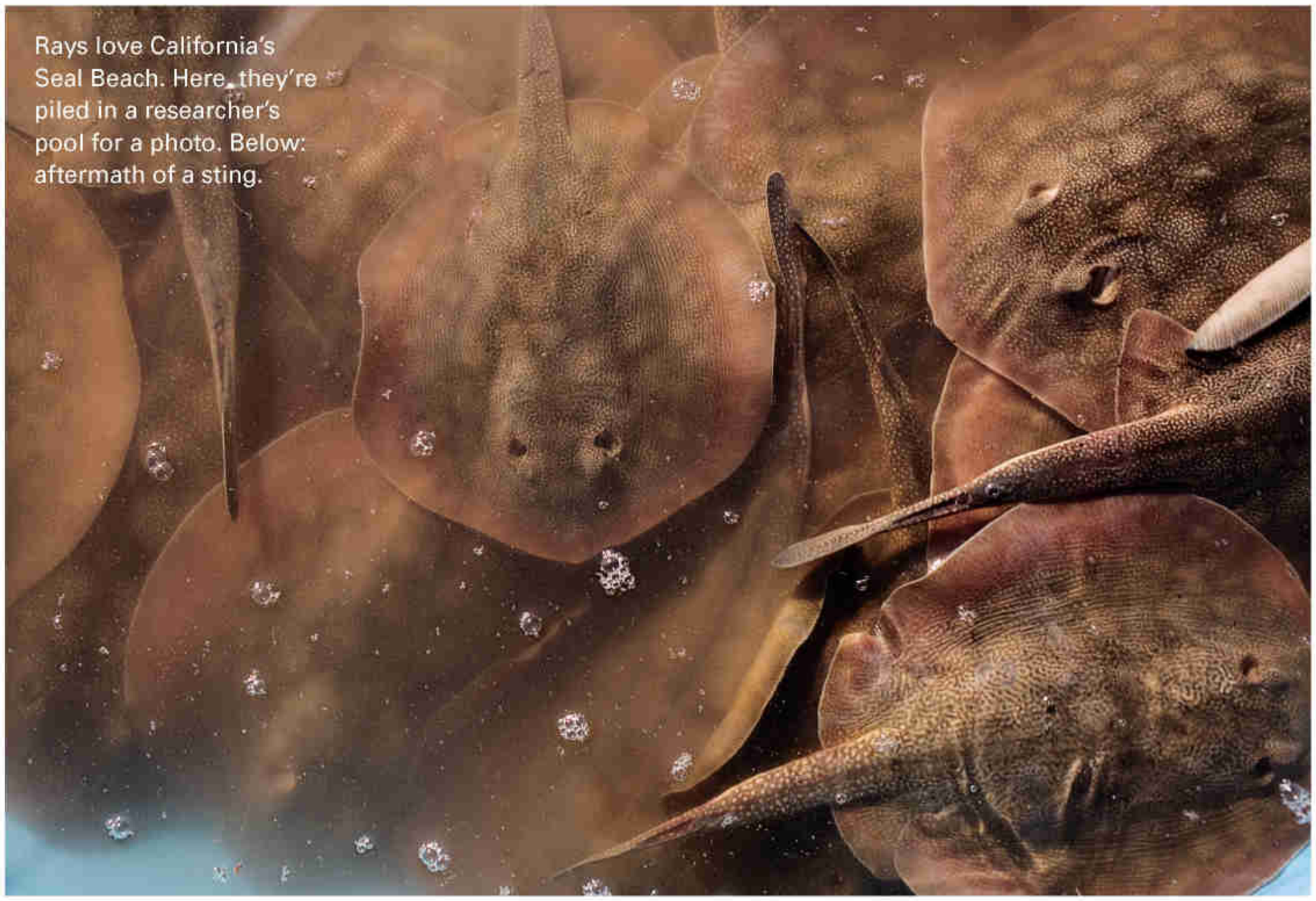


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Rays love California's Seal Beach. Here, they're piled in a researcher's pool for a photo. Below: aftermath of a sting.

Stingray Shuffle Surfers like California's Seal Beach, and so do stingrays. The beach has been a popular hangout for the fish since at least the 1950s; from May to November, they pile up just past where the waves break. The rays are probably drawn to the warm water, which comes from power plants that use seawater for cooling, then discharge it into the San Gabriel River, where it flows to the ocean. They also like fine sediment that settles on the seafloor thanks to manmade jetties. Savvy humans tread carefully, sliding their feet through the sand. The vibrations alert the rays, which swim away. A stepped-on ray may lash out with the poisonous spine on its tail. Marine biologist Chris Lowe, of California State University, Long Beach, has studied the ways of rays for seven years. He says moving the rays away from Seal Beach won't help. They swim back. Killing them, as has been done in the past, doesn't noticeably reduce the population. Neither does clipping their spines. They'll grow new ones. For now, Seal Beach surfers just have to shuffle through the stingrays. —*Helen Fields*





STINGRAY STATS

- **Range** Round stingrays *(Urobatis halleri)* live from California to Panama.
- **Sting** Venom from the tail's poisonous spine hurts for hours.
- **Victims** On average, 250 people are stung each year at Seal Beach alone.
- **Treatment** Soaking the wound in hot water helps.

PHOTOS: MIGUEL LUIS FAIRBANKS

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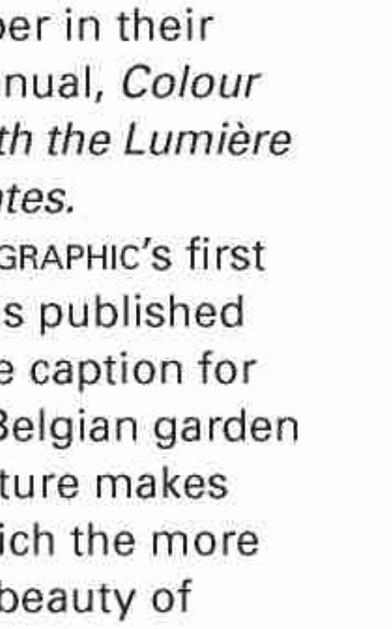


A glass plate Autochrome of a Swiss fisherman and his catch (top and inset) gets its color from dyed potato starch grains (fish's eye detail, below).



100 Years of Autochromes

The world got a little brighter a century ago. The Autochrome, the first practical color photographic process, became available to the public in 1907. Brothers Auguste and Louis Lumière had patented the method, which uses dyed potato starch grains affixed to glass plates to filter light, three years earlier. The public was smitten. "One is hardly prepared for the fidelity with which the process reproduces the most delicate nuances of colour," wrote George E. Brown and C. Welborne Piper in their 1907 how-to manual, *Colour Photography with the Lumière Autochrome Plates.*



NATIONAL GEOGRAPHIC's first Autochrome was published in July 1914. The caption for the image of a Belgian garden exults, "The picture makes one wonder which the more to admire—the beauty of the flowers or the power of the camera to interpret the luxuriant colors so faithfully." The GEOGRAPHIC kept using Autochromes for another two decades. But the introduction of Kodachrome color film in the mid-1930s finally made the process obsolete. Today Autochromes are largely a lost art. All the great practitioners are gone, and for the most part, their knowledge was never passed on. Photographers just don't make colors like that anymore.

—Margaret G. Zackowitz

AUTOCHROME: HANS HILDENBRAND, NATIONAL GEOGRAPHIC IMAGE COLLECTION. PHOTOS: REBECCA HALE, NGS STAFF

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WHERE IN THE WORLD?

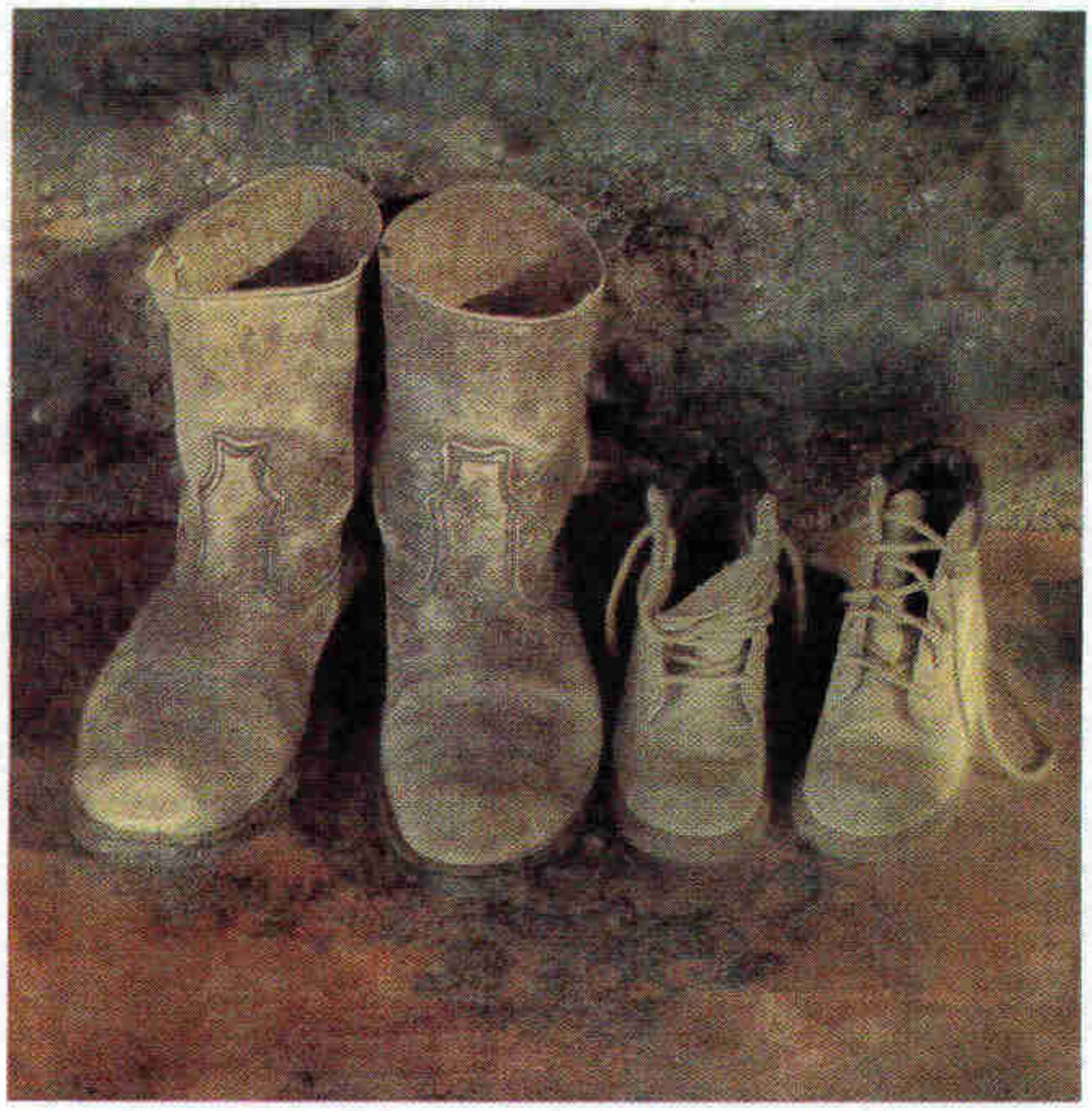


Irrigation equipment pivots around a 99-acre cornfield near Kalomo, Zambia. Wavy contours control rain runoff; nonfertile patches pock the field.

Crop Circles In 1948 a farmer named Frank Zybach rigged together the first center-pivot irrigation prototype near Strasburg, Colorado. Today his designs are spinning around the world.

In Zambia, where drought can beget famine, pivot irrigation represents a huge technological leap. Center pivots use half as much water as traditional methods and require less tillage—which translates into far greater yields. The machines also operate unmanned, freeing farmers to plant, reap, sell, and sleep while the long, wheeled sprinklers inch around their fields like the hands of a clock, 24 hours a day. Large commercial farms own a majority of the country's pivots, but a new national irrigation plan is intended to spread the wealth. "In the next five years," according to Minister of Agriculture Ben Kapita, "Zambia's maize production will triple." And that has small-scale farmers seeing green. *—Oliver Uberti*

PHOTO: MICHAEL POLIZA



Jess' and Christopher's Boots, Alexander Mountain Estate, Alexander Valley

KENDALL-JACKSON

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Heirlooms: Roxbury Russet (at right), the tiny Lady Apple, and Calville Blanc d'Hiver.

Heirlooms Blossom U.S. apples came on hard times in the 20th century. Farmers chopped down cider apple trees to conform to the laws of Prohibition, and a wicked Northeastern freeze in 1934 knocked out other types. But the resurgence of farmers markets has revived interest in antique apple varieties, says Ian Merwin, a pomologist at Cornell University and himself an apple grower.

So the hunt is on for the thousands of heirloom apples. Ezekiel Goodband, orchard manager at Scott Farm in Dummerston, Vermont, collects cuttings the way other folks collect stamps. He finds heirloom trees in old orchards and farmsteads. He'll graft a twig to the trunk of an existing tree to propagate the old apples.

The resulting fruit gives new meaning to the cliché about comparing apples to apples. In the U.S., 20 varieties make up about 90 percent of commercially sold apples. Most are bred for beauty and long shelf life; they can taste sugary and bland. The heirloom Roxbury Russet, on the other hand, tastes like guava—an intense though not overwhelming sweetness. And nearly every heirloom has a story. Petite and citrusy Lady Apples, cultivated by the ancient Romans, were prized by European women at court, who'd tuck one into a corset for emergencies—an early version of a breath mint.

Yet heirloom apples will probably remain a niche market. Newer commercial varieties of apple are more pest resistant. Many heirlooms fell out of favor for a reason. "Sheepnose apples look cute," says Merwin, "but they taste god-awful." —*Linda Kulman*

APPLE LORE

- **History** Originally from Central Asia, apples spread along the Silk Road throughout Europe and Asia, most likely crossing the Atlantic on the *Mayflower.*
- **Early American** Still raised today, the green Roxbury Russet is likely the first named U.S. apple, dating from the mid-1600s.
- **Top crop** The popular Red Delicious started out as the Hawkeye apple, grown in Iowa in the late 1800s.

PHOTO: REBECCA HALE, NGS STAFF

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[1] UNAIDS/WHO (December 2006), AIDS Epidemic Update
[2] *FORTUNE*, March 19, 2007
[3] *Ethisphere™ Magazine*, April 2007

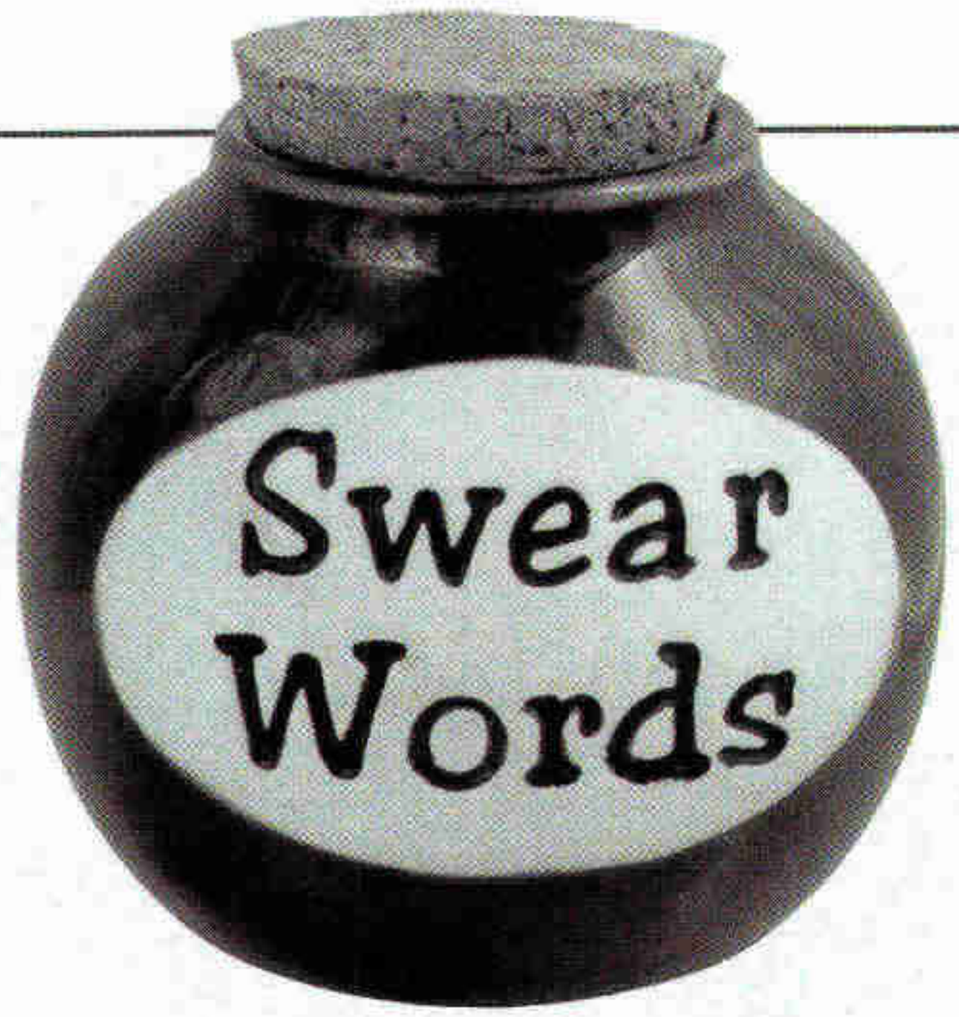
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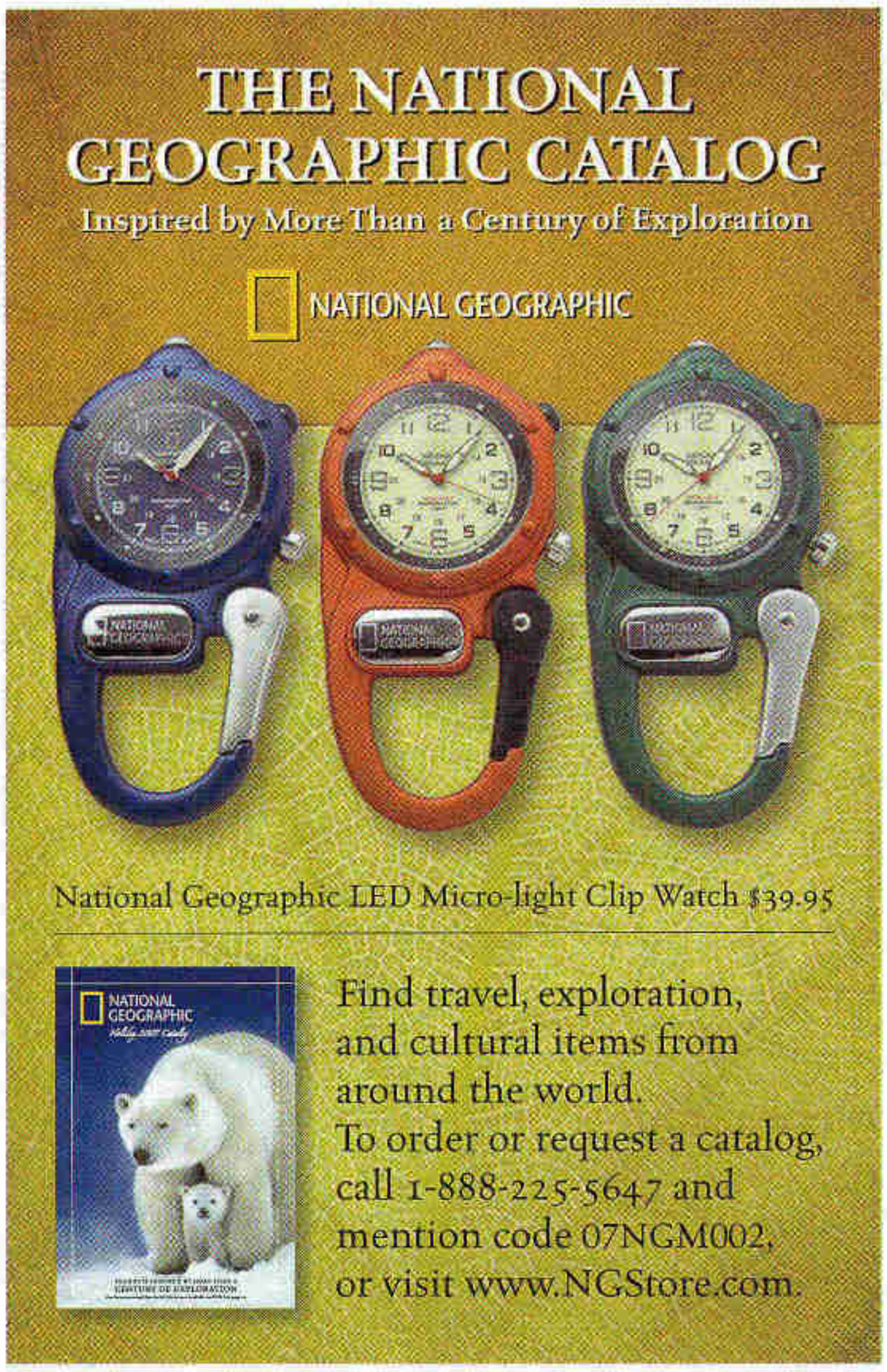
$#!&* or a child's future?

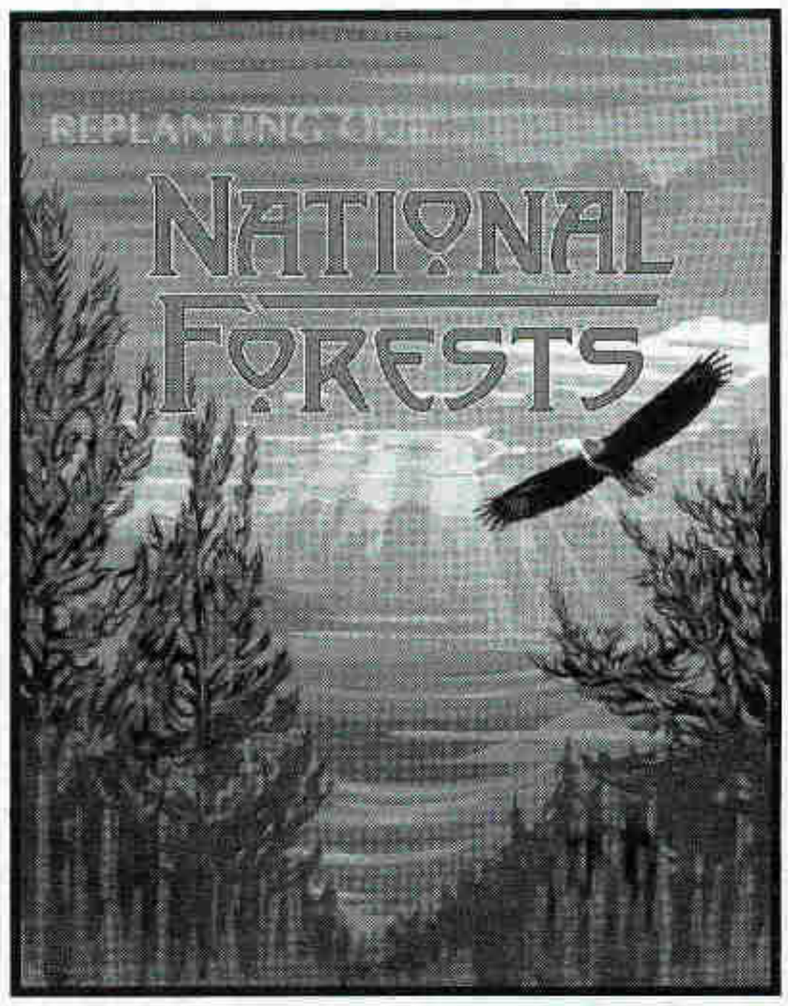


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A Japanese ship hauls up a minke whale off the coast of Antarctica.



THE HUNT GOES ON

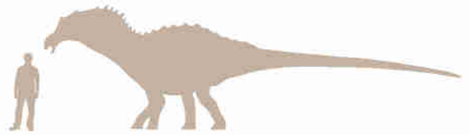
- **Ban** In 1986, the International Whaling Commission put a ban on commercial whaling; some nations defy it.
- **Loophole** The ban allows "scientific whaling." In Japan, the meat ends up in markets.
- **Victims** Hunting caused bigger whales to decline. Now minkes, about 30 feet long, are being targeted.

Accidental Whaling If you're a fisherman in South Korea's part of the Sea of Japan and a minke whale is trapped in your net and dies, you can sell its meat legally if you tell the government about the bycatch. From 1999 to 2003, fishermen reported 458 whales. To check these numbers, researchers bought whale meat at South Korean markets several times over the same period and used genetic analysis to see how many whales the meat came from. They estimated that more than 800 minkes hit the market. Since one whale can bring up to $100,000, scientists suspect not all the deaths are accidental. "Is this just another form of commercial whaling?" asks Scott Baker, the Oregon State University biologist who led the study. "If so, it needs to be regulated." Otherwise, the minkes in the Sea of Japan could soon be gone. *—Helen Fields*

PHOTO: JEREMY SUTTON-HIBBERT, GREENPEACE

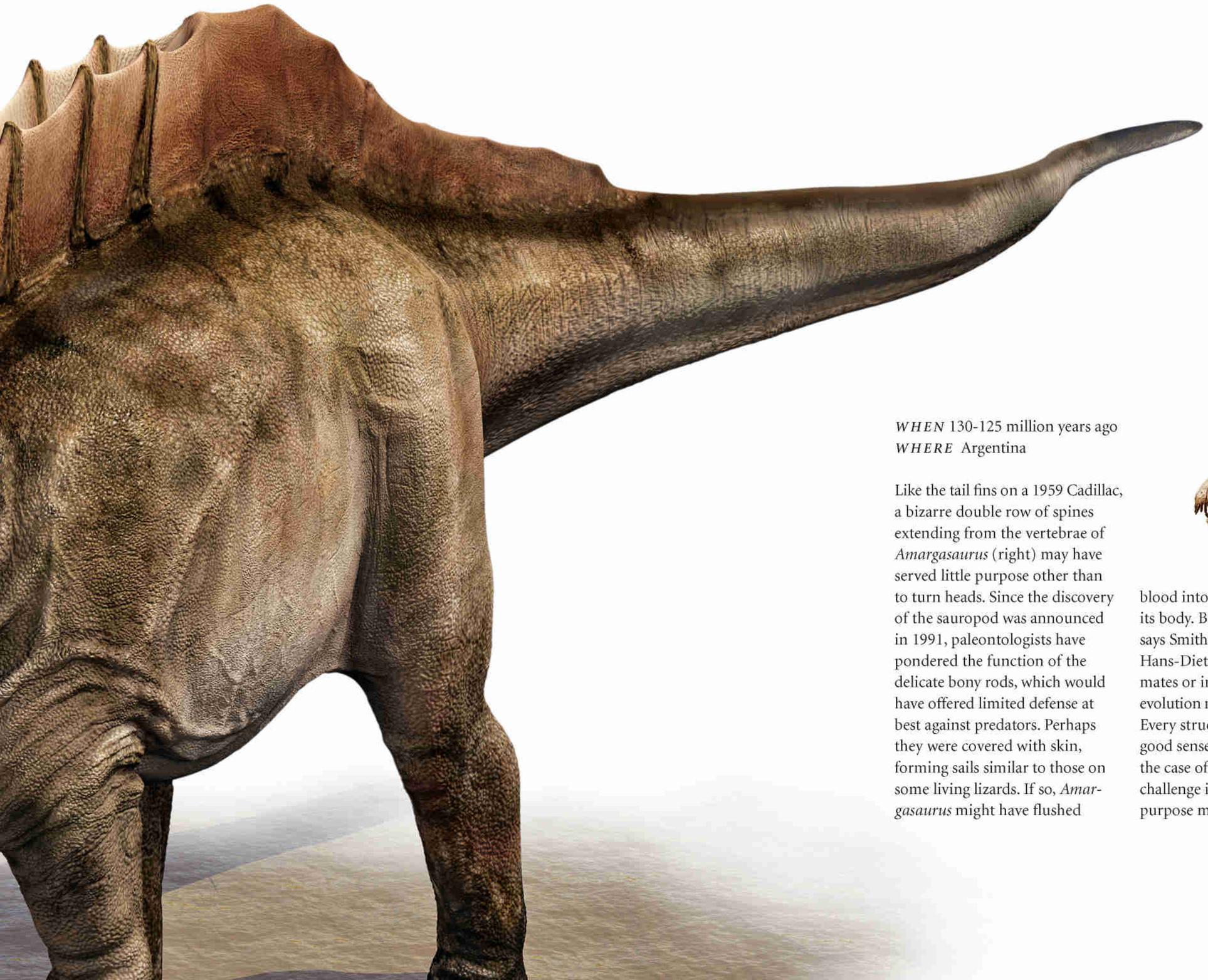


AMARGASAURUS



X-FACTOR

Double row of spines on neck and back





WHEN 130-125 million years ago
WHERE Argentina

Like the tail fins on a 1959 Cadillac, a bizarre double row of spines extending from the vertebrae of *Amargasaurus* (right) may have served little purpose other than to turn heads. Since the discovery of the sauropod was announced in 1991, paleontologists have pondered the function of the delicate bony rods, which would have offered limited defense at best against predators. Perhaps they were covered with skin, forming sails similar to those on some living lizards. If so, *Amargasaurus* might have flushed blood into the sails to help cool its body. But their likely function, says Smithsonian paleontologist Hans-Dieter Sues, was to attract mates or intimidate rivals. "In evolution nothing is really bizarre. Every structure makes perfectly good sense to the organism. In the case of extinct animals the challenge is to identify what the purpose might have been."

BASE MODELS FOR ALL DINOSAURS BY 422 SOUTH.

ART BY RENEGADE 9; FOSSIL PHOTOGRAPHED AT MUSEO ARGENTINO DE CIENCIAS NATURALES (MACN), BUENOS AIRES. SKULL SHOWN IS A SPECULATIVE CAST.

EXTREME DINOSAURS

A bizarre gallery of Mesozoic monsters prompts JOHN UPDIKE *to ask: What has evolution wrought?*

Photographs | IRA BLOCK

Art | PIXELDUST STUDIOS · RENEGADE 9

Art Text | PETER GWIN NATIONAL GEOGRAPHIC STAFF



CARNOTAURUS



X-FACTOR

Bull horns, tiny arms

WHEN 82-67 million years ago
WHERE Argentina

Consider the evolutionary hand dealt to *Carnotaurus*, or "meat-eating bull": a big, bad, but seemingly underequipped predator, as if nature had set out to design a perfect killing machine but ran out of funding. Powerful jaws and long, agile legs suggest a highly mobile hunter prowling the lakeshores of what is now Patagonia.

Its skull (left), constructed like a battering ram, features a stout pair of horns. Yet accompanying this formidable hardware are tiny arms (even more stunted than the famously puny arms of *Tyrannosaurus rex*) and surprisingly small teeth. Some scientists, like University of Chicago paleontologist Paul Sereno, envision *Carnotaurus* and its kin as dinosaurian hyenas—fleet of foot and short-snouted to track down and gnaw on carcasses. "Who needs arms for that?" he asks.



Society Grants Research on several dinos in this story is supported by your Society membership.

ART BY PIXELDUST STUDIOS;
FOSSIL PHOTOGRAPHED AT MACN, BUENOS AIRES

ESSAY BY JOHN UPDIKE

Before the 19th century, when dinosaur bones turned up they were taken as evidence of dragons, ogres, or giant victims of Noah's Flood.

After two centuries of paleontological harvest, the evidence seems stranger than any fable, and continues to get stranger. Dozens of new species emerge each year; China and Argentina are hot spots lately for startling new finds. Contemplating the bizarre specimens recently come to light, one cannot but wonder what on earth Nature was thinking of. What advantage was conferred, say, by the ungainly eight-foot-long arms and huge triple claws of *Deinocheirus?* Or, speaking of arms, by *Mononykus*'s smug dependence on a single, stoutly clawed digit at the end of each minimal forearm? Guesses can be hazarded: The latter found a single stubby claw just the thing for probing after insects; the former stripped the leaves and bark from trees in awesome bulk. A carnivorous cousin, *Deinonychus,* about the size of a man, leaped on its prey, wrapped its long arms and three-fingered hands around it, and kicked it to the death with sickle-shaped toenails.

Tiny *Epidendrosaurus* boasted a hugely elongated third finger that served, presumably, a clinging, arboreal lifestyle, like that of today's aye-aye, a lemur that possesses the same curious trait. With the membrane they support, the elongated digits of bats and pterosaurs enable flight, and perhaps *Epidendrosaurus* was taking a skittery first step in that direction. But what do we make of such apparently inutile extremes of morphology as the elaborate skull frills of ceratopsians like *Styracosaurus* or the horizontally protruding front teeth of *Masiakasaurus knopfleri,* a late Cretaceous oddity recently uncovered in Madagascar by excavators who named the beast after Mark Knopfler, the lead singer of the group Dire Straits, their favorite music to dig by?

Masiakasaurus is an oddity, all right, its mouth bristling with those slightly hooked, forward-poking teeth; but, then, odd too are an elephant's trunk and tusks, and an elk's antler rack, and a peacock's tail. A difficulty with dinosaurs is that we can't see them in action and tame them, as it were, with visual (and

John Updike is the author of 22 novels and numerous collections of stories, poems, and essays. His latest novel is Terrorist. *Ira Block has photographed 32 features for* National Geographic. *Pixeldust Studios and Renegade 9 provide animation and visual effects for film and TV. This collaboration is their first contribution to the magazine.*

auditory and olfactory) witness. How weird might a human body look to them? That thin and featherless skin, that dish-flat face, that flaccid erectitude, those feeble, clawless five digits at the end of each limb, that ghastly utter lack of a tail —*ugh.* Whatever did this creature *do* to earn its place in the sun, a well-armored, nicely specialized dino might ask.

Dinosaurs dominated the planet's land surface from some 200 million years ago until their abrupt disappearance, 135 million years later. The vast span of time boggles the human mind, which took its present, *Homo sapiens* form less than 200,000 years ago and began to leave written records and organize cities less than 10,000 years in the past. When the first dinosaurs—small, lightweight, bipedal, and carnivorous—appeared in the Triassic, the first of three periods in the Mesozoic geologic era, the Earth held one giant continent, Pangaea; during their Jurassic heyday Pangaea split into two parts, Laurasia and Gondwana; and by the late Cretaceous the continents had something like their present shapes, though all were reduced in size by the higher seas, and India was still an island heading for a Himalaya-producing crash with Asia. The world was becoming the one we know: The Andes and the Rockies were rising; flowering plants had appeared, and with them, bees. The Mesozoic climate, generally, was warmer than today's, and wetter, generating lush growths of ferns and cycads and forests of evergreens, ginkgoes, and tree ferns close to the Poles; plant-eating dinosaurs grew huge, and carnivorous predators kept pace. It was a planetary summertime, and the living was easy.

Not *that* easy: Throughout their long day on Earth, there was an intensification of boniness and spikiness, as if the struggle for survival became grimmer. And yet the defensive or attacking advantage of skull frills and back plates is not self-evident. The solid-domed skull of *Pachycephalosaurus,* the largest of the bone-headed dinosaurs, seems made for butting—but for butting what? The skull would do little good against a big predator like *Tyrannosaurus rex,* which had the whole rest of *Pachycephalosaurus*'s unprotected body to bite down on. Butting matches amid males of the same species were unlikely, since the bone, though ten inches thick, was not shock-absorbent. The skulls of some pachycephalosaurs, moreover, were flat and thin, and some tall and ridged—bad designs for contact sport. Maybe they were just used for discreet pushing. Or to make a daunting impression.

An even more impractical design shaped the skull of the pachycephalosaurid *Dracorex hogwartsia*—an intricate sunburst of spiky horns and knobs, without a dome. Only one such skull has been unearthed; it is on display, with the playful name derived from Harry Potter's school of witchcraft and wizardry,

PARASAUROLOPHUS



X-FACTOR

Trombone crest

WHEN 76 million years ago
WHERE North America

in Indianapolis's Children's Museum. Duck-billed *Parasaurolophus walkeri,* another late Cretaceous plant-eater, sported a spectacular pipelike structure, sweeping back from its skull, that was once theorized to act as a snorkel in swimming. But the tubular crest had no hole for gathering air. It may have served as a trumpeting noisemaker, for herd communication, or supported a bright flap of skin beguiling to a *Parasaurolophus* of the opposite gender. Sexual success and herd acceptance perpetuate genes as much as combative prowess and food-gathering ability.

Dinosaurs have always presented adaptive puzzles. How did huge herbivores like *Brachiosaurus, Apatosaurus,* and *Diplodocus* get enough daily food into their tiny mouths to fill their cavernous guts? Of the two familiar dinosaurs whose life-and-death struggle was memorably animated in Walt Disney's 1940 *Fantasia* (though in fact they never met in the corridors of time, failing to overlap by fully 75 million years), *T. rex* had puzzlingly tiny arms and *Stegosaurus* carried on its back a double row of huge bony plates negligible as defensive armor and problematic as heat controls. Not that biological features need to be efficient to be carried along. Some Darwinian purists don't even like the word "adaptive," as carrying a taint of implied teleology, of purposeful self-improvement. All that is certain is that dinosaur skeletons demonstrate the viability, for a time, of certain dimensions and conformations. Yet even Darwin, on the last page of *The Origin of Species,* in summing up his theory as "Natural Selection, entailing Divergence of Character and the Extinction of less-improved forms," lets fall a shadow of value judgment with the "less-improved."

FOSSIL PHOTOGRAPHED AT THE ROYAL ONTARIO MUSEUM (ROM), TORONTO



The tubular bone sweeping back from a *Parasaurolophus walkeri* skull has inspired a variety of theories about its function. Weapon? Breathing tube? Hypersensitive nose? None of the above? Aided by computer modeling, scientists now think it was used to generate sounds like a trombone, though it also may have played a role in sexual display.

In what sense are living forms improvements over the dinosaurs? All life-forms, even such long-lasting ones as blue-green algae and horseshoe crabs and crocodiles, will eventually flunk some test posed by environmental conditions and meet extinction. One can safely say that no dinosaur was as intelligent as *Homo sapiens,* or even as chimpanzees. And none that are known, not even a heavyweight champion like *Argentinosaurus,* was as big as a blue whale. One can believe that none was as beautiful in swift motion as a cheetah or an antelope, or as impressive to our mammalian aesthetic sense as a tiger. But beyond this it is hard to talk of improvement, especially since for all its fine qualities *Homo sapiens* is befouling the environment like no fauna before it.

The dinosaurs in their long reign filled every niche several times over, and the smallest of them—the little light-boned theropods scuttling for their lives underfoot—grew feathers and became birds, still singing and dipping all around us. It is an amazing end to an amazing evolutionary story—*Deinonychus* into dove. Other surprises certainly lurk within the still unfolding saga of the dinosaurs. In Inner Mongolia, so recently that the bones were revealed to the world just this past spring, a giant birdlike dinosaur, *Gigantoraptor,* has been discovered. It clearly belongs among the oviraptorosaurs of the late Cretaceous—90-pound weaklings with toothless beaks—but weighed in at one-and-a-half tons and could have peered into a second-story window. While many of its fellow theropods—for example, six-foot, large-eyed, big-brained *Troodon*—were evolving toward nimbleness and intelligence, *Gigantoraptor* opted for brute size. But what did it eat, with its enormous toothless beak? Did its claw-tipped arms bear feathers, as did those of smaller oviraptorosaurs?

The new specimens that emerge as tangles of bones embedded in sedimentary rock are island peaks of a submerged continent where evolutionary currents surged back and forth. Our telescoped perspective gives an impression of a violent struggle as anatomical ploys, some of them seemingly grotesque, were desperately tried and eventually discarded. The dinosaurs as a group saw myriad extinctions, and the final extinction, at the end of the Mesozoic, looks to have been the work of an asteroid. They continue to live in the awareness of their human successors on the throne of earthly dominance. They fascinate children as well as paleontologists. My second son, I well remember, collected the plastic dinosaur miniatures that came in cereal boxes, and communed with them in his room. He loved them—their amiable grotesquerie, their guileless enormity, their unassuming small brains. They were eventual losers, in a game of survival our own species is still playing, but new varieties keep emerging from the rocks underfoot to amuse and amaze us. □



ART BY PIXELDUST STUDIOS;
FOSSIL FROM THE COLLECTION OF THE
UNIVERSITÉ D'ANTANANARIVO, MADAGASCAR

MASIAKASAURUS



X-FACTOR

Inscrutable teeth



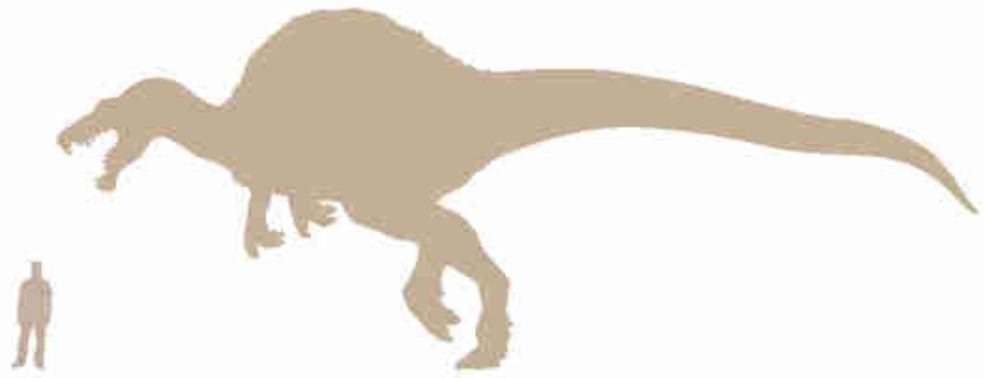
WHEN 70-65 million years ago
WHERE Madagascar

The mouth of *Masiakasaurus* speaks to how this German-shepherd-size meat-eater survived in the river basins of northwestern Madagascar, near the end of the dinosaurs' reign. But what is it saying? Stony Brook University paleontologist David Krause led the team that found the remains, including part of the lower jaw (fossil shown below). *Masiaka-saurus* has long, conical front teeth with hooked tips that curl out of its mouth—unique among theropods—while its back teeth are more typically blade-like and serrated. So how did it use such a specialized mouth? "Our best guess is the teeth up front were used to stab small prey, perhaps mammals, lizards, and/or birds," says team member Scott Sampson of the University of Utah, "and the teeth at the rear of the jaw were then used to tear up the kill." Despite its formidable dentition, *Masiakasaurus* was likely prey itself for crocs and other large carnivores, like the 20-foot-long theropod *Majungasaurus*, with which it shared territory. Against such monsters, its best defenses would have been speed and agility.



ACTUAL SIZE

SPINOSAURUS



X-FACTOR

High-spined giant

WHEN 97 million years ago
WHERE North Africa

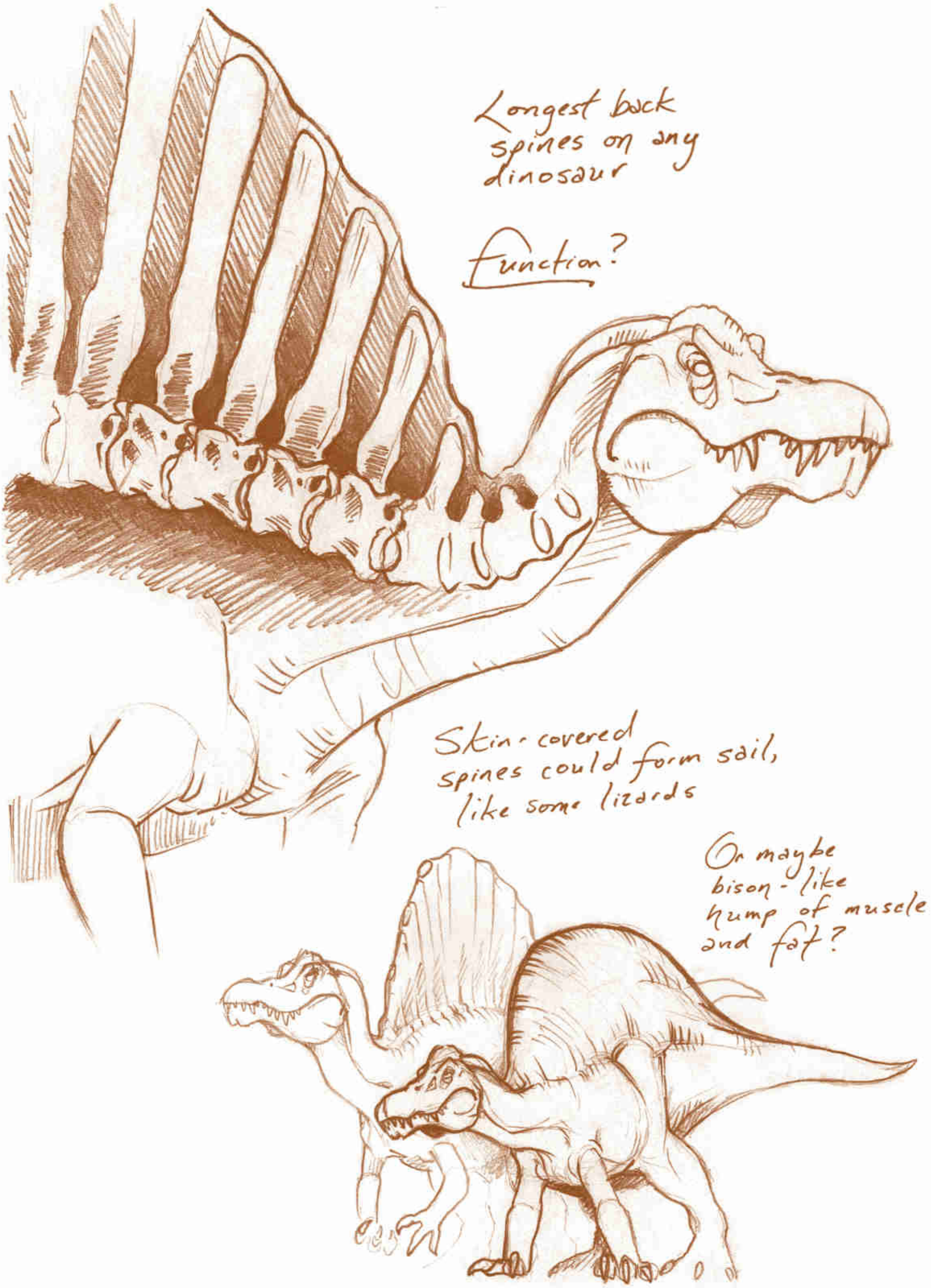
In 1912 a collector for German paleontologist Ernst Stromer emerged from the Egyptian desert with the remains of the biggest predatory dinosaur the world had ever seen. The creature may have measured more than 50 feet long—arguably still the largest terrestrial carnivore known. It possessed crocodile-like teeth and a row of enormous spines (some six feet long) projecting from the vertebrae, which prompted Stromer to name the beast *Spinosaurus.* Scientists have argued over the function of the spines ever since. The debate offers insight into one of the key questions paleontologists face: How do you reconstruct a flesh-and-blood dinosaur from just a few bones?

One way is to piece together clues by comparing the new specimen with more complete skeletons already in hand. Scientists also draw inferences from the extinct animal's environment and the way living creatures function with analogous skeletal equipment. Naturally, the less one has of a specimen, the more speculative become the reconstructions—and the more heated the controversy surrounding them. Over the years, many scientists have argued that *Spinosaurus*'s vertebral projections were connected by a fleshy membrane. Some living lizards employ similar "sails" for sexual display. Perhaps *Spinosaurus* too sported a sail to win the attention of mates, as some paleontologists hypothesize about *Amargasaurus* (pages 32-4). The sail may also have helped *Spinosaurus* regulate body temperature, serving as a radiator to cool the blood, much as a car radiator cools the water circulating through an engine.

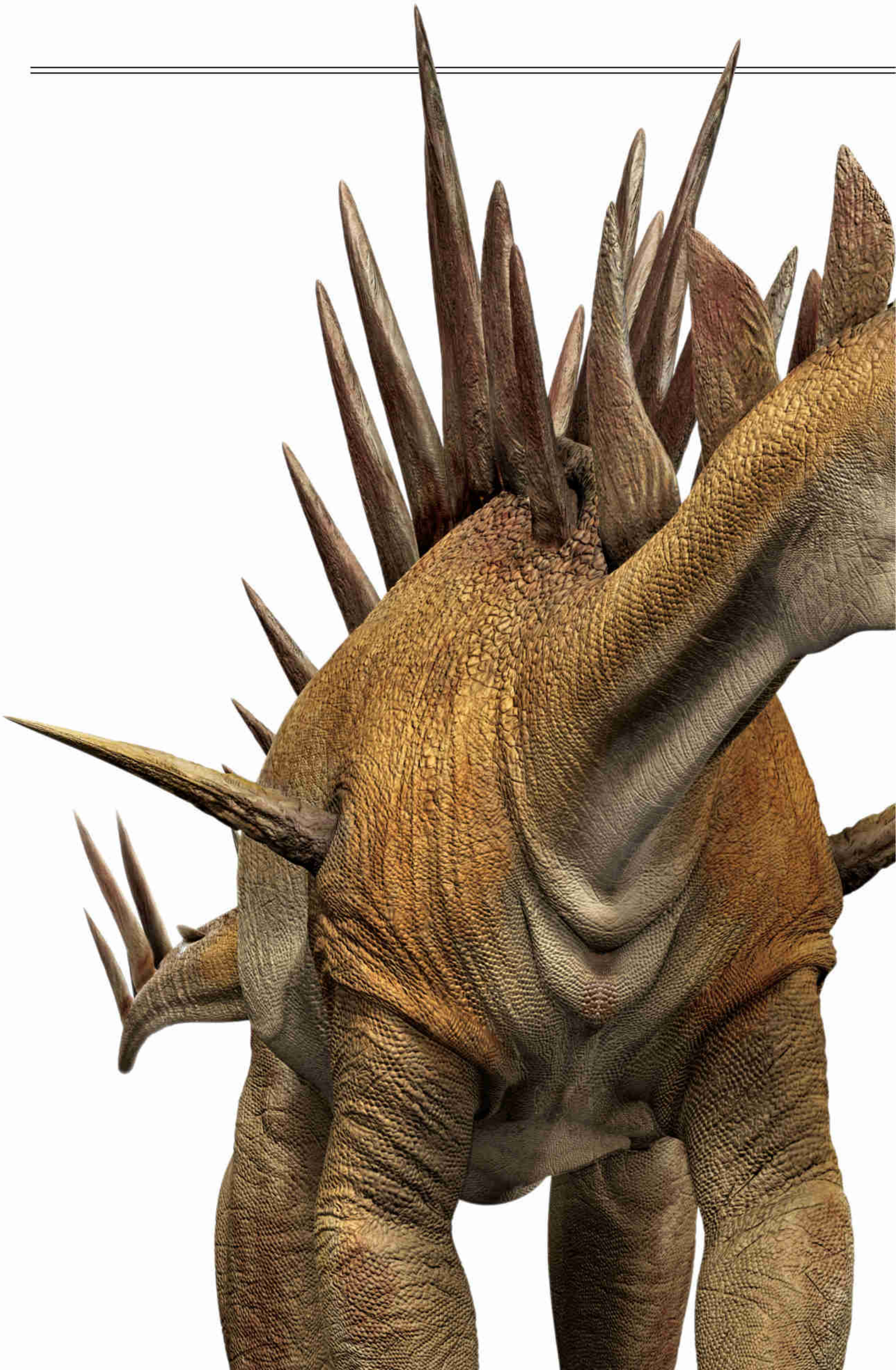
Then again, perhaps the various renderings of a sail-bearing *Spinosaurus* have all missed the mark. As Smithsonian paleontologist Hans-Dieter Sues points out, other related dinosaurs, such as *Baryonyx,* regulated their body temperature just fine, sans sail. Sues seconds a notion put forth a decade ago by Jack Bowman Bailey of Western Illinois University: The spines instead supported a structure similar to a bison's hump. "If *Spinosaurus* had puny, slender spines, they might have supported a sail, but these were very massive," says Sues. "It makes more sense that *Spinosaurus*'s spines were embedded in a lot of muscle and tissue."

Other scientists argue that humps are usually found on herbivores in arid environments, while *Spinosaurus,* a carnivore, appears to have been living in a coastal mangrove forest. Paleontologist Paul Sereno ascribes to the theory that the spines supported a sail for sexual display. *Suchomimus,* a closely related predecessor, had much smaller vertebral spines. Millions of years later, says Sereno, "*Spinosaurus* took that trait to the extreme."

How do you build a dinosaur from bones like these?



ART BY JASON C. POOLE



TUOJIANGOSAURUS



X-FACTOR

Shoulder spikes







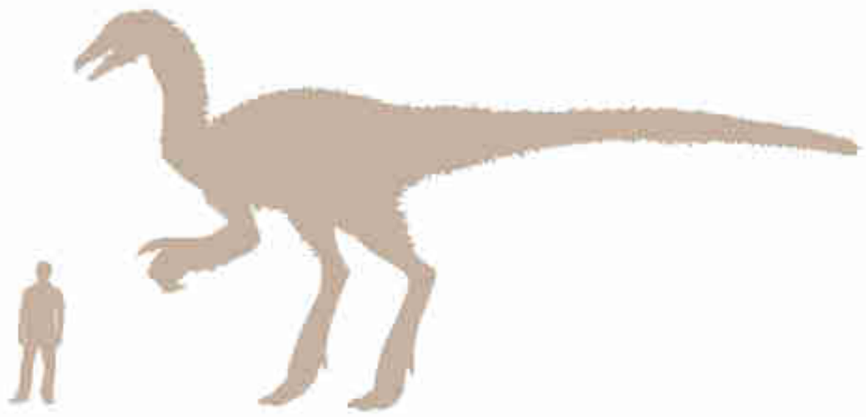
SIZE: 33 INCHES

WHEN 161-155 million years ago
WHERE China

With a thorny tail and rows of bony plates along its back, *Tuojiangosaurus,* like its better known cousin *Stegosaurus,* resembles a Jurassic tank. What grants this ponderous Chinese herbivore admission to the ranks of the truly bizarre, however, is the long, tapering spike thrusting out from each shoulder. "The shoulder spikes [fossil at left] would have helped protect its vulnerable flanks, which would have been right at the level of an attacking allosaur," says University of Maryland paleontologist Thomas Holtz. As for the plates on its back, their purpose is a matter of much debate, says Susannah Maidment, a paleontologist at Cambridge University. Early armored dinosaurs were covered with small scutes to protect against a predator's bite, a trait passed on more or less unchanged to some of their descendants. But in others such as *Tuojiangosaurus,* the scutes gave way to plates along the backbone, which perhaps made the animal look bigger, but offered little protection. A large theropod, says Maidment, would have been able to chomp through them "like potato chips."

ART BY PIXELDUST STUDIOS; FOSSIL PHOTOGRAPHED AT THE INSTITUTE OF VERTEBRATE PALEONTOLOGY AND PALEOANTHROPOLOGY (IVPP), BEIJING

DEINOCHEIRUS



X-FACTOR

Enormous arms, giant claws

WHEN 70 million years ago
WHERE Mongolia

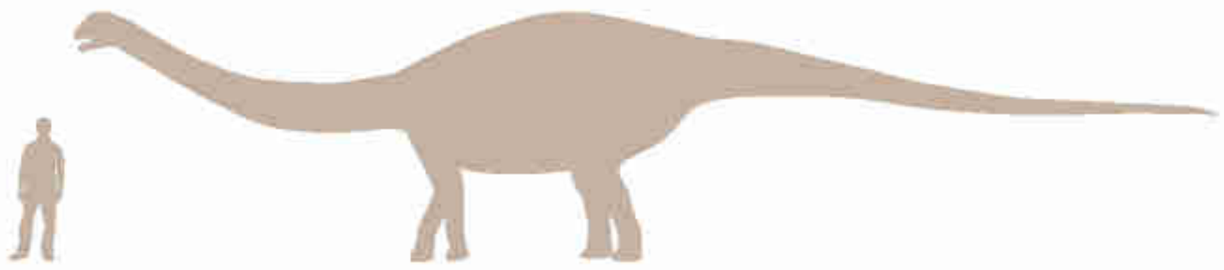
Whose arms are these? The question has puzzled paleontologists for nearly four decades. Unearthed in Mongolia near an assortment of predatory dinosaur remains, the reconstructed limbs each measure eight feet long, tipped with ten-inch claws. But few other parts of the original find have ever been recovered. Paleontologists dubbed the creature *Deinocheirus* ("terrible hand") and tried to match the bones with those of known species. Anatomically, *Deinocheirus*'s forearms and hands seem most similar to those of ornithomimids, a group of fleet-footed dinosaurs that resembled

ostriches and used their arms for grasping prey. Yet when scientists try to estimate *Deinocheirus*'s size based on a general ratio of arms-to-body size in this group, the calculations project a massive animal 40 feet long (silhouette), putting it among the largest known theropods, such as *Carcharodontosaurus.* Or perhaps it's a smaller dinosaur with outlandishly long arms (modeled below). "The body is a mystery," says Thomas Holtz. "It might not be an ornithomimid at all. But then what is it?"



ART BY PIXELDUST STUDIOS;
FOSSIL FROM THE COLLECTION OF THE
MONGOLIAN ACADEMY OF SCIENCES

NIGERSAURUS



X-FACTOR

Shovel-like mouth, 600 teeth

WHEN 110 million years ago
WHERE North Africa

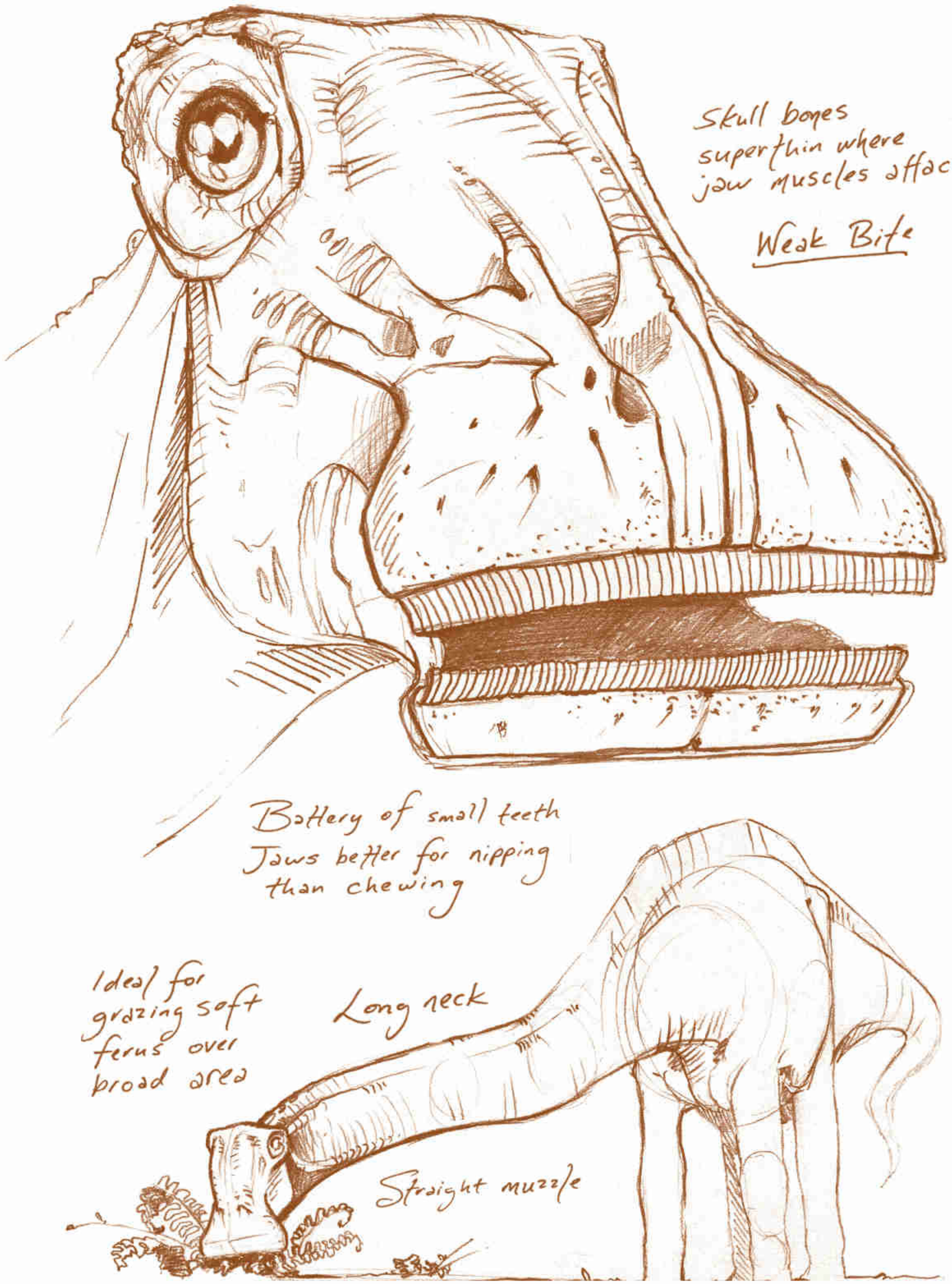
Does natural selection ever paint a species into a corner, leaving it with anatomy so specialized that a slight change in its environment pushes it over the edge into extinction? Consider the 50-foot-long diplodocoid (a branch of the sauropod group) *Nigersaurus*—an anatomical sideshow with a mouth shaped like a vacuum cleaner, hundreds of tiny teeth, a boom of a neck, and skull bones thin to the point of translucence. How did it survive with such a preposterous eating apparatus? Paleontologist Paul Sereno, a National Geographic explorer-in-residence, picked up the quizzical beast's trail in the mid-1990s in northeastern Niger. *Nigersaurus*'s oddest feature is its broad, straight-edged muzzle, which allowed the business end of its mouth to work very close to the ground, "like a lawn mower," says Sereno. Its 600 teeth, each about the size of a toddler's incisor, were tightly aligned, with a single row of more than 50 in operation in each jaw at any one time. A CT scan exposed up to eight "replacements" stacked up behind each tooth, so that new teeth immediately filled in for worn ones. Despite its impressive battery of teeth, *Nigersaurus* had a weak bite. Where the jaw muscles attach to the skull, the bone is as thin as a paper plate.

"Its mouth appears designed for nipping rather than chomping or chewing," says Sereno, pointing to wear patterns that suggest the teeth slid by one another like a pair of shears. With nearly 80 percent of the animal's skeleton recovered, a portrait emerges of a finely tuned eating machine designed to crop mouthfuls of soft plants growing near the rivers that coursed through what is now the Sahara's southern flank. Its long neck would have allowed *Nigersaurus* to mow down an entire field of plants without taking a single step.

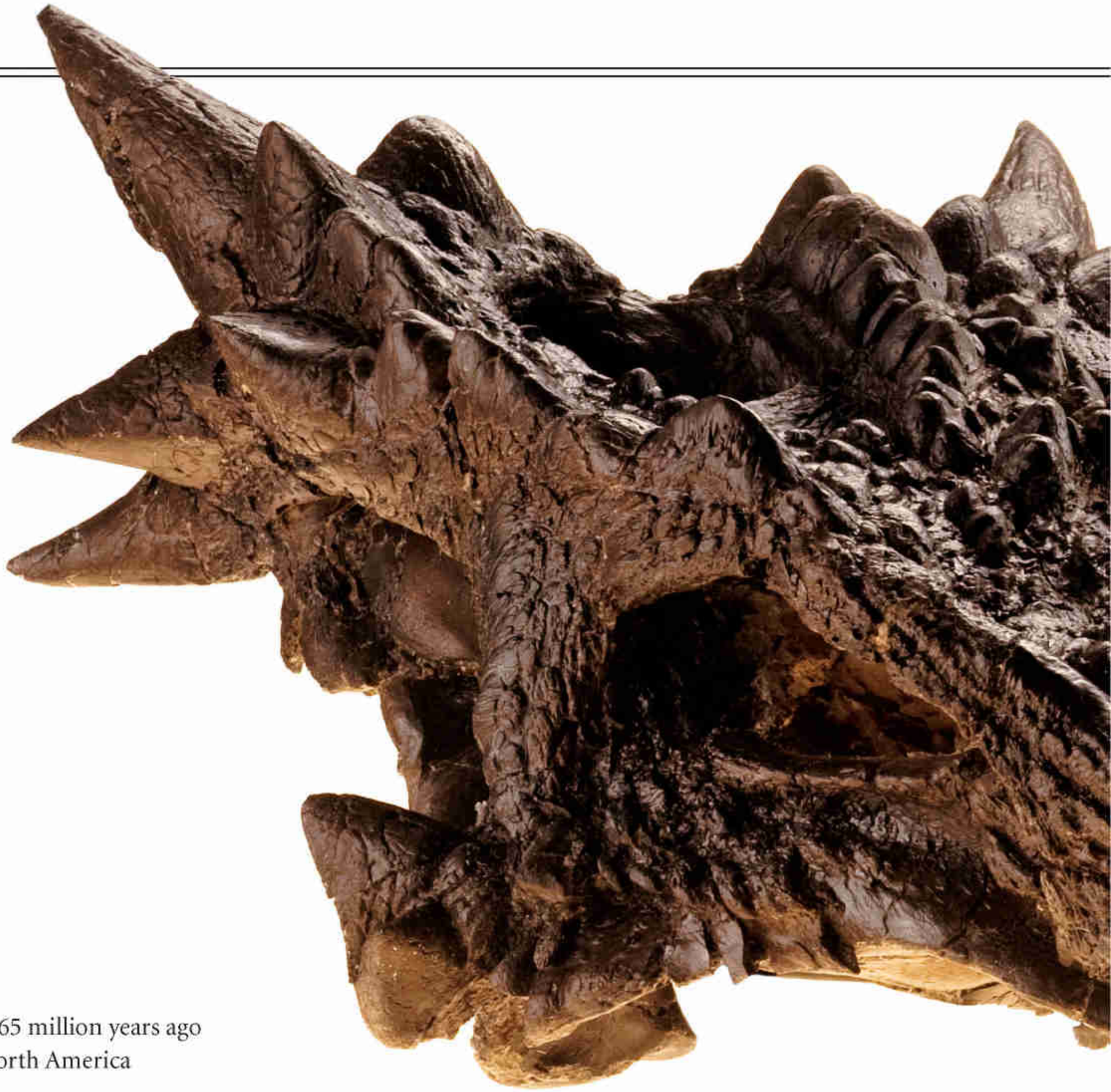
A number of these features, seen in the extreme in *Nigersaurus,* show up over millions of years in other diplodocoids, which thrived on nearly every major land-

Its peculiar mouth was the perfect tool. But for what?

mass. That, says Sereno, suggests that this feeding strategy emerged in primitive form much earlier. But could this evolutionary trend toward the perfect eating machine ultimately have led to the extinction of the lineage? "Selection can favor specialization that can be advantageous over the short run, but create vulnerabilities over the long haul," says University of Chicago evolutionary biologist David Jablonski. We'll never know for sure whether *Nigersaurus* fell victim to its own outlandishness. But while it lasted, this fern-eating giant was a bizarre and beautiful success.



ART BY JASON C. POOLE



WHEN 67-65 million years ago
WHERE North America

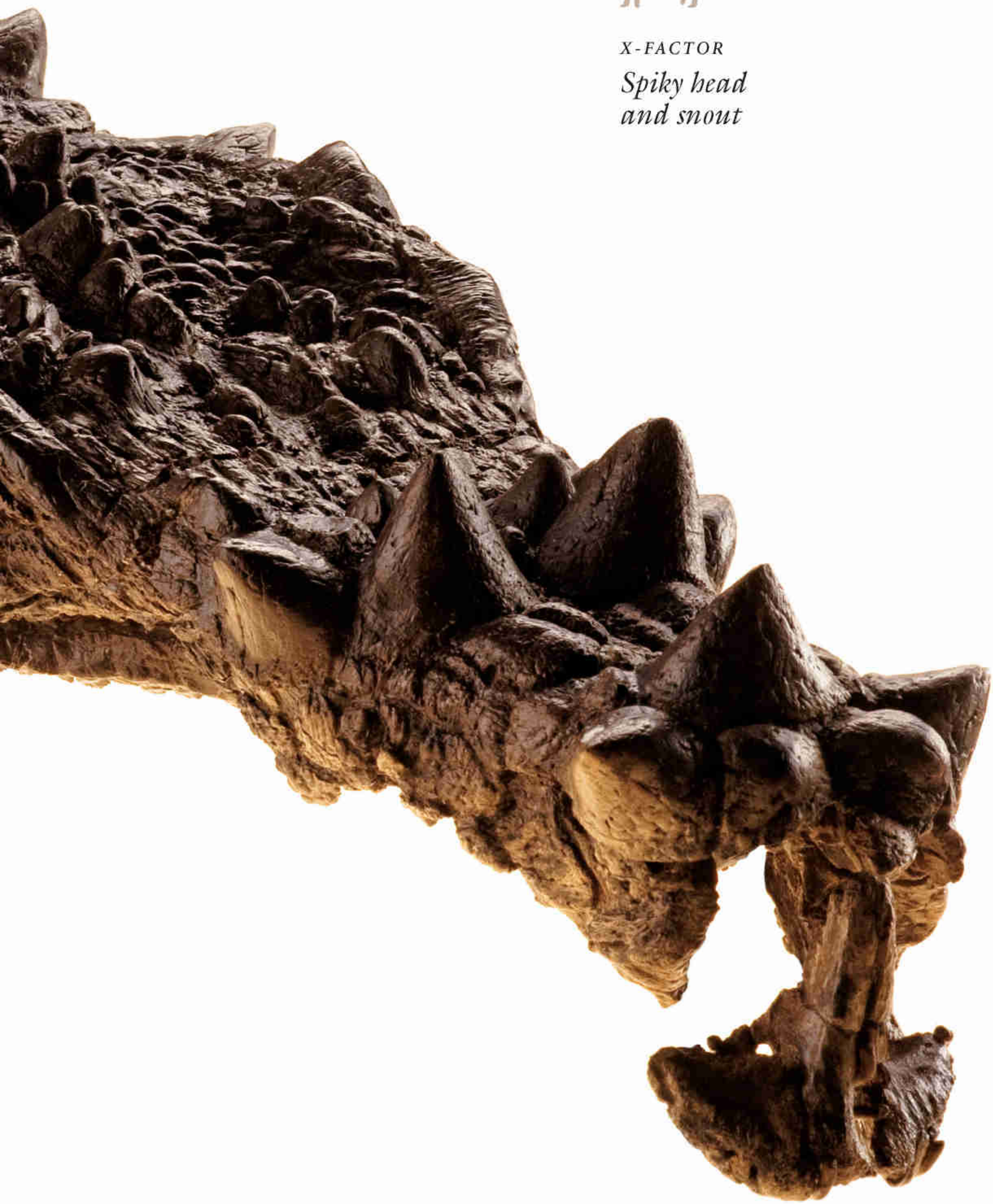
Bristling with spikes and pointed knobs, the skull of a *Dracorex* looks like something forged in medieval legend. Yet the creature it belonged to probably resembled a flower-eating wild pig more than the fire-breathing "dragon king" its name implies. Found by amateur fossil hunters in the South Dakota part of the Hell Creek formation, *Dracorex* has been assigned by paleontologists Robert Bakker and Robert Sullivan to the plant-eating pachycephalosaur family. Many species in this group had thick domes atop their skulls, which, like a bighorn sheep's horns, may have allowed them to use their heads as battering rams. Could *Dracorex,* with its relatively flat skull, also have been a headbanger? Why not? asks Bakker. He points to the giant forest hog of Africa, which uses a similarly flat skull and long muzzle to defend against predators and ram its rivals in violent clashes over mates. Endowed with flesh and skin, *Dracorex* stares out from this magazine's cover.

DRACOREX



X-FACTOR

Spiky head and snout



FOSSIL PHOTOGRAPHED AT THE
CHILDREN'S MUSEUM OF INDIANAPOLIS



EPIDENDROSAURUS



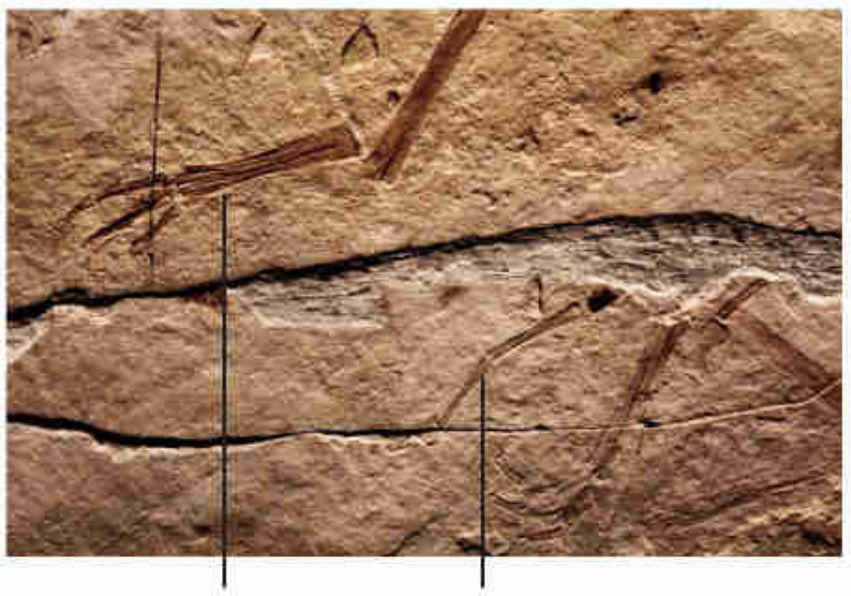
X-FACTOR

Tiny body, elongated finger

WHEN 160 million years ago
WHERE China

At the diminutive end of the extreme dinosaur spectrum perches tiny *Epidendrosaurus*, a sparrow-size theropod with grossly oversize hands. Described in 2002 by paleontologists at the Chinese Academy of Sciences, it is the smallest known dinosaur, excluding birds, though scientists remain unsure whether the bones and impressions (below), discovered in siltstone in Inner Mongolia, are those of an adult or a juvenile. A more vexing question: What was it doing with its disproportionate hands, with third fingers longer than the other two digits combined? The closest modern comparison is to the aye-aye, a lemur that inhabits Madagascar's dense forest canopies and uses a similarly elongated finger to probe holes in trees for grubs and insects. It is also possible, says Thomas Holtz, that *Epidendrosaurus* might have had birdlike plumage. "But until we find more specimens, we can't say."





ART BY PIXELDUST STUDIOS;
FOSSIL PHOTOGRAPHED AT IVPP, BEIJING

STYRACOSAURUS



X-FACTOR

Massive horned frill

WHEN 75 million years ago
WHERE North America

Like an armor-laden knight, *Styracosaurus* would have cut an imposing figure on the forested river plains in what is now Alberta, Canada. Multiple individuals of these rhino-size herbivores have been identified in the same bone beds, suggesting they traveled in herds. Horned dinosaurs are a well-understood group, says Hans-Dieter Sues, and since *Styracosaurus* lived near the end of this lineage, we can trace the evolutionary paths that led to it. "Its ancestors began with a little bump over their nose and then developed a little bit of a frill at the back of the skull," says Sues, "but *Styracosaurus* takes these traits to the top." The bump on the nose in ancestral species evolved into an enormous spike that would have given *Styracosaurus* a potent weapon to fight off predators and fend off rivals. Meanwhile, the skull frill enlarged and added a profusion of horns, which probably let other styracosaurs identify it from a distance. Some scientists have suggested blood pumped into the skin covering the frill could have caused it to change color, possibly to attract mates or to scare enemies. "These extreme traits just didn't suddenly appear," says Sues. "There were compelling reasons why they were selected and pushed down the evolutionary line." □



Troodon or False? How much did you learn in school about dinosaurs that was all wrong? Take our quiz at **ngm.com** and find out.



ART BY RENEGADE 9;
SKULL PHOTOGRAPHED AT ROM, TORONTO

The little town where Jesus was born is now one of the most contentious places on Earth.

Bethlehem 2007 A.D.

A once busy commercial street now dead-ends at the Israeli security barrier. On the other side of the still growing wall, Jewish settlers near Bethlehem feel safer. Inside, Palestinians feel trapped.

Strong in faith if not in number, Palestinian Christians attend Mass in the grotto of the Church of the Nativity, said to be the birthplace of Jesus. A century ago Christians made up 90 percent of Bethlehem's population. Now down to a third, they continue to flee the city.


ALELUYA



An abandoned building fills in as a playground for Palestinian boys on a hill above Bethlehem. Some 35,000 people are crowded into an urban space constricted by the Israeli barrier. Since the wall went up, the economy has collapsed, led by a plunge in tourism.

By Michael Finkel
Photographs by Christopher Anderson

This is not how Mary and Joseph came into Bethlehem,

but this is how you enter now. You wait at the wall. It's a daunting concrete barricade, three stories high, thorned with razor wire. Standing beside it, you feel as if you're at the base of a dam. Israeli soldiers armed with assault rifles examine your papers. They search your vehicle. No Israeli civilian, by military order, is allowed in. And few Bethlehem residents are permitted out—the reason the wall exists here, according to the Israeli government, is to keep terrorists away from Jerusalem.

Bethlehem and Jerusalem are only six miles apart, though in the compressed and fractious geography of the region, this places them in different realms. It can take a month for a postcard to go from one city to the other. Bethlehem is in the West Bank, on land taken by Israel during the Six Day War of 1967. It's a Palestinian city; the majority of its 35,000 residents are Muslim. In 1900, more than 90 percent of the city was Christian. Today Bethlehem is only about one-third Christian, and this proportion is steadily shrinking as Christians leave for Europe or the Americas. At least a dozen suicide bombers have come from the city and surrounding district. The truth is that Bethlehem, the "little town" venerated during Christmas, is one of the most contentious places on Earth.

If you're cleared to enter, a sliding steel door, like that on a boxcar, grinds open. The soldiers step aside, and you drive through the temporary gap in the wall. Then the door slides back, squealing on its track, booming shut. You're in Bethlehem.

The city, at the scrabbly hem of the Judaean desert, is built over several broad, flat-topped hills, stingy with vegetation. The older homes are made of pale yellow stone, wedged along steep, narrow streets. A couple of battered taxis ply the roads, drivers heavy on the horns. At an outdoor stall, lamb meat rotates on a spit, dripping fat. Men sit on plastic chairs and sip from small glasses of thick Arabic coffee. There's an odor of uncollected garbage. As you work your way up the hill, you can see the scope of the wall and chart its ongoing expansion—a gray snake, segmented by cylindrical guard towers, methodically constricting the city.

Inside the wall, along Bethlehem's borders, are three Palestinian refugee camps, boxy apartments heaped atop one another in haphazard piles. Every breeze through the camps' alleys ruffles the corners of hundreds of martyrs' posters—young men, staring impassively, some gripping M-16s. Many are victims of the Israel Defense Forces. Others have blown themselves up in an Israeli mall or restaurant or bus. Arabic text on the posters extols the greatness of these deeds.

Just outside the wall, dominating the surrounding high points and ridges, are sprawling Jewish settlements, skewered with construction cranes, feverishly growing. Late in the afternoon the sun glints off the settlement buildings and Bethlehem seems circled by fire.

At the summit of Bethlehem's central hill is Manger Square, a cobblestoned plaza fronting the Church of the Nativity. The tallest and most prominent structure here is a mosque. Many of the gift shops are shuttered, relics of a more peaceful time. Tourism is low; religious pilgrims are shuttled in and out by guides—a quick stop at Manger Square, then a speedy departure down the hill and back out through the wall, returning to Jerusalem. Hotels are mostly empty. Few visitors spend the night. Unemployment in Bethlehem, by the mayor's estimate, is 50 percent,



At Checkpoint 300, the sole crossing between Bethlehem and Jerusalem, Israeli soldiers search a car heading out of town. Only Palestinians with rarely granted Israeli-issued permits are allowed through the heavily guarded steel door.

and many families are living from meal to meal.

The Church of the Nativity is almost hidden. It looks like a stone fortress, walls several feet thick, with a facade devoid of ornamentation. Perhaps this is why it has survived 14 centuries: Bethlehem is no place for delicate architecture. A spot at the crossroads of the world—the busy intersection of Europe, Asia, and Africa—means a perpetual rush hour of invading armies. The church has endured conquests by Persian, Byzantine, Muslim, Crusader, Mamluk, Ottoman, Jordanian, British, and Israeli forces. The entrance, reduced in size over the centuries, perhaps to prevent access by travelers' horses and camels, has shrunk to a miniature hole. You nearly have to fold yourself in half to get through.

The interior of the church, cool and dark, is as spare as the outside; four rows of columns in an open nave lead to the main altar. There are no pews, just a collection of cheap folding chairs. But beneath the altar, down a set of worn limestone steps, is a small cave. In the rural areas of Bethlehem, today as it was 2,000 years ago, grottoes are used as livestock pens. Mangers are carved out of rock. Here, in the bull's-eye of this volatile place, ringed by Jewish settlements, imprisoned within a wall, encircled by refugee camps, hidden amid a forest of minarets, tucked below the floor of an ancient church, is a silver star. This, it's believed, is where Jesus was born.

Some of the people you meet around Bethlehem quote from the Bible, some recite from the Koran, some chant from the Torah. Some show you their fields, some point to their olive groves; some invoke history, some envision the future. Some pray with knees on the ground, some with foreheads on the ground, some with feet firmly planted but with torsos turning and swaying. Some throw stones and some drive tanks and some wrap themselves with explosives. But when you get right down to it, when you boil away the hatred and the politics and the wars that have shaken the planet, the one thing most people are talking about, when it comes to Bethlehem, is land. A tiny scrap of land. A wind-scoured, water-starved, rock-strewn bit of ground.

THE JEWS GOT HERE FIRST. That's what the rabbi says. Rabbi Menachem Froman lives in the Jewish settlement of Tekoa, perched on a mesa,



Aglow at dusk, church spires punctuate Bethlehem's old quarter. The distant hill marks the site of the fortress of Herod the Great, ruler of Judaea in the first century B.C. A sign of today's dominant faith, the unlit minaret of Omar Mosque rises from Manger Square.

a clean collection of bleached stone houses capped with red-tiled roofs, double strollers parked on several porches. Fifteen hundred people live here. From the north side of Tekoa, Froman can view all of Bethlehem; the Muslim call to prayer drifts over the settlement five times a day, steady as a train schedule. To the south are the bald brown knolls of the Judaean wilderness, where Jesus is thought to have fasted for 40 days, and the deep ravines that tumble down, down, down, falling below sea level—even the terrain here seems to defy reason—and then plunging still, to Earth's lowest point, the Dead Sea.

"This is not just land," says Froman, his long white beard spilling from his chin, unruly as a river rapid. "This is the Holy Land. There's no oil, no gold, no diamonds. It's a desert! But this is God's palace." Froman is 62 years old; he can count back 17 generations of rabbis in his family. He's the 18th. His son is also a rabbi.

Michael Finkel reported on malaria in the July 2007 issue of National Geographic. *Christopher Anderson was named 2006 Magazine Photographer of the Year for his work in Gaza, Venezuela, and Lebanon.*

He was born in what is now Israel but was then, during World War II, known as the British Mandate for Palestine (the British began governing the region in 1922, following the collapse of the Ottoman Empire). After World War II, in the wake of the Holocaust, the United Nations voted to partition the region into two states—one Jewish, one Arab. Jews accepted the plan, Arabs did not. Fighting between Arabs and Jews began even before Israel declared independence, in 1948, and the ensuing war resulted in about 750,000 Palestinians fleeing their native villages, many of them forced to do so by the Israeli army. Many relocated to the West Bank of the Jordan River, administered by Jordan, or the Gaza Strip, governed by Egypt. These were the first Palestinian refugees.

Then, in 1967, Israel defeated the military forces of Egypt, Jordan, Syria, Iraq, and Lebanon in six chaotic days and occupied, among other lands, the West Bank, a place many Israelis refer to by its biblical name, Judaea and Samaria. This initiated the settlement movement—Jews establishing homesites throughout the newly won territory.

Froman was one of the first to go. He believes, as do many settlers, that the Jews' deed to Judaea and Samaria is spelled out in the Old Testament. They are the landlords. Froman therefore feels he has the right, granted from God, to live here.

In the district of Bethlehem, which includes the city and neighboring villages, there are about 180,000 Palestinians, of whom 25,000 or so are Christian (virtually all living in urban Bethlehem and two satellite towns, Beit Jala and Beit Sahur). Woven into this map are 22 Jewish settlements, with a population approaching 80,000, and at least a dozen more frontier-style squatter encampments known as outposts, often no more than a ring of dilapidated mobile homes, like Conestoga wagons around a campfire.

Just looking out his window in Tekoa, Froman sees why everyone craves a piece of this land. For Jews still awaiting their Messiah, Froman says it's possible that he will arrive right here, in the eroded backcountry of Bethlehem, the presence of God palpable in the desert's sandpaper wind. For Christians anticipating their Messiah's return, why shouldn't he come back to the spot he was born? Muslims do not believe in a messiah—there is only Allah, only God—but Palestinian Muslims also revere this land as sacred, since Jesus is one of their prophets. Also Bethlehem and the surrounding West Bank, as well as the Gaza Strip and Jerusalem, are where they hope to establish a viable homeland.

The United Nations, the European Union, and the International Court of Justice have declared the Israeli settlements illegal, a violation of the Geneva Convention that prohibits occupying powers from allowing its citizens to populate the territory it occupies. The Israeli government, though, provides easy loans to those seeking houses in West Bank settlements. One of the largest in the Bethlehem area is called Har Homa. Its gleaming high-rises stand so close to Bethlehem—just across the wall—that it seems as if you could hold your arm out on a Palestinian street corner and hail a cab in Har Homa. It has become a full-fledged suburb, with 2,000 Israelis. About half of all settlers consider themselves nonreligious, and real estate ads in Har Homa, plastered on numerous billboards, stress the town's secular advantages. Reasonable prices; great location; such an easy commute to Jerusalem!

Har Homa exemplifies an Israeli strategy known as "facts on the ground": The more Jews who live in a concentrated area on the east side of the so-called Green Line—the armistice line established in 1949 following Israel's war of independence—the more likely the area will become part of Israel if the region is divided into two countries. Palestinians still refer to Har Homa by its original name, Jabal Abu Ghuneim—in Arabic, "mountain of the shepherd." It used to be one of the last open spaces in Bethlehem, a pine-shaded hillside where shepherds tended their flocks, and had done so since biblical times. Construction began in 1997; the land was shaved flat and stacked with apartment towers. Not one Palestinian who owned acreage was compensated. Its new name means "walled mountain" in Hebrew.

"Can you imagine Bethlehem without any Christians? You better start imagining it, because in a few years, it might be reality."

The settlements are designed to feel like safe, suburban oases, but they are not. The presence of settlers, so close to Palestinian towns, makes them a target of particularly fierce enmity. Stones once shattered car windshields so often that many settlers replaced the glass in their vehicles with rock-resistant plastic. Before the wall was built, stray bullets, fired from below, sometimes burst into homes. In the settlement of Efrat, a few hills over from Tekoa, one suicide bomber detonated his bomb inside the medical center. Another was shot to death as he was about to blow himself up in the settlement's supermarket. He was killed not by a soldier but by a settler.

"Our children have been to more funerals than most people have *(Continued on page 72)*

A latecomer enters a line of Palestinians who wait for hours, starting before dawn, to clear a checkpoint for day jobs outside the wall. Many work in construction, hired to build the Israeli settlements and security barrier that hem them in.






ISRAEL
Jerusalem
WEST BANK
Bethlehem
1949 ARMISTICE (GREEN) LINE
PLANNED BARRIER
BARRIER EXISTING OR UNDER CONSTRUCTION
Maale Adummim
Gilo
Checkpoint 300
Har Homa
Aida
Beit Jala
Beit Jibrin
Rachel's Tomb
Omar Mosque
Manger Square
Church of the Nativity
Beit Sahur
Beitar Illit
Duheisha
Neve Daniel
Rosh Zurim
Efrat
Herodion
Tekoa
Kfar Etzion
Authority
Israeli settlement
Israeli-controlled area
Palestinian-controlled area
Palestinian-administered area (partly under Israeli military control)
Roads
Major road
Israeli-controlled road
Checkpoint, roadblock, or other road closure
Refugee camp
0 mi 2
0 km 2
SOURCES: UNITED NATIONS OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS; B'TSELEM
M. BRODY DITTEMORE
MARGUERITE B. HUNSIKER
NGM MAPS



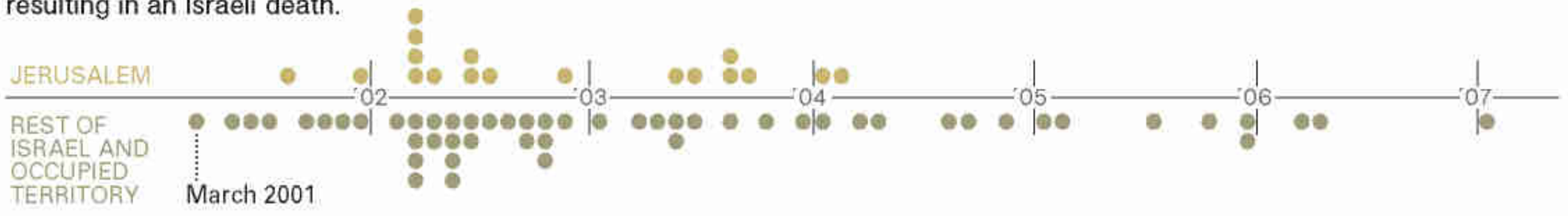
Bethlehem Walled In

The 24-foot-high wall encircling Bethlehem on three sides provides a canvas for defiant slogans (above). It is part of a 450-mile barrier, more than half complete, that will annex 10 percent of the West Bank as it encloses dozens of Jewish settlements east of the Green Line. Palestinian farmers with land on the Israeli-controlled side of the wall must have daily permission from the Israeli army to work their fields. Even inside the wall a shepherd (left), can expect to run into checkpoints and closed military zones.

Critics denounce the barrier as a land grab to create new borders for Israel. Israeli officials defend it as a deterrent to suicide bombers, citing the decrease in attacks, especially in Jerusalem, since construction began in 2003 as evidence the wall is working (graph, below). But many experts say increased intelligence and arrests of suspected terrorists—plus a ban on suicide bombing by militant Palestinian leaders—are equally responsible for the downturn in violence.



Suicide Bombings, by month, resulting in an Israeli death.



been to in their whole lives," says Sara Bedein, a mother of six who lives in Efrat. "All my kids have friends, neighbors, classmates who have been killed." Bedein wears a bright scarf on her head—Orthodox Jewish women, like traditional Muslims, do not display their hair in public. She says that, after one school-bus bombing tore off the legs of three young students and killed two teachers, her daughter and schoolmates began sitting cross-legged on the bus, believing it would reduce the chance of losing limbs in an attack. And yet, if you ask Bedein why her family doesn't move out of the occupied territory, she answers immediately and unequivocally: "We love it here." She loves the views, the mountain air, the settlers' tight sense of community.

Many settlers keep sidearms strapped to their waists, sheriffs in their own Wild West. Some even carry weapons to synagogue, and while praying, while raising their arms, beseeching God, it's clear that any protection they seek is not solely divine: There is the unmistakable glint of a handgun snapped into a holster.

The Israeli occupation felt, to Palestinians, like a series of humiliations—a proud people reduced to dependency on their hated foe.

When Seth Mandell takes a short walk in the wilderness, he carries his nine-millimeter Glock in a fanny pack. Mandell lives in Tekoa, a couple of streets away from Rabbi Froman. His hike has become a ritual of grief. He works his way down a steep, slippery trail, speckled with scarlet wildflowers, bursts of color in the dun desertscape. A few doves circle above. Doves in the sky; olive branches beneath.

Mandell is heading toward a small grotto, a tranquil spot where, he says, monks have come to meditate since the fifth century. No surprise that a 13-year-old boy was inspired to explore. The boy was Koby Mandell, Seth's son. He cut school one day, in May 2001, with his 14-year-old friend Yosef Ishran, also from Tekoa. They hung out in this low-ceilinged cave. Perhaps they sat in the cool shade and looked out the entrance: a spectacular view of a rocky canyon, the walls dropping sere and still into a dry riverbed below.

When night fell and the boys had not returned home, searches were initiated. Soldiers arrived. The next morning, Koby and Yosef were found in the cave. They had been bludgeoned to death with stones. The walls of the cave were smeared with their blood. Next to the bodies lay their lunch bags, with uneaten sandwiches and bottles of water. The killers were never caught. The pain Seth Mandell feels when he walks down here seems to emanate from him like heat waves off a sidewalk. But Mandell says that he and his family—his wife and their three other children—have no plans to leave. He says what Rabbi Froman says. He says what many settlers say. His connection to this land is spiritually, emotionally, and culturally profound. "Leaving," he says, "would be leaving a part of myself behind."

ONE THOUSAND YEARS before Christ was born, Bethlehem was known as the City of David. It was the birthplace of King David, a Jewish leader who earned his esteem through a famous fight: He defeated Goliath, striking him dead with a stone flung from his sling. The giant, whose height, according to the Old Testament, "was six cubits and a span"—about ten feet—was a member of the Philistine people, ancient enemy of the Jews. From the word "Philistine" has derived the current Palestinian, though the two are linked only etymologically, not by blood.

Though rarely in power, the Jews were the most populous group in the region for centuries. But by the first century A.D., following a series of ineffective rulers and defeats by the Roman army, they were cast out of the Holy Land. For the next 2,000 years, the Jews scattered throughout the world—the Diaspora—but they never stopped praying for a return to their native soil.

In the meantime, Christianity rose to prominence. It seems a fluke that Jesus was born in Bethlehem—after all, he's Jesus of Nazareth, a



With the Jewish settlement of Har Homa visible from his window, Abdullah Abu Sheirah awaits the return of a son, jailed in Israel on charges of aiding a group tied to terrorist activities. Boys hang Palestinian flags for a party to celebrate his release.

town 90 miles to the north. Some archaeologists and theological historians have their doubts about many of the details of the Christmas story, including that Jesus was born in Bethlehem of Judaea. There is a small village, also called Bethlehem, located closer to Nazareth, where some believe Jesus was actually born. (In Hebrew, the name Bethlehem means "house of bread," and could refer to almost any place with a flour mill.)

But according to the New Testament, in the Book of Luke, the Roman emperor at the time, Caesar Augustus, was conducting a census that required all people to return to their hometowns to register. Joseph was a descendant of King David, and even though his wife was nearing the end of her pregnancy, they completed the journey to Bethlehem. Famously, the Book of Luke relates, "there was no room for them in the Inn," so Jesus was born amid the livestock, perhaps in the grotto over which the Church of the Nativity was eventually built.

Judaea's ruler, King Herod, was so disturbed by reports that a new king and potential rival had been born that, according to the Book of Matthew, he sent troops to kill all boys under age two. Mary and Joseph escaped with Jesus to Egypt, but thousands of children were reported to have been slaughtered.

By the fourth century, Christianity was the official religion of the Roman Empire, and Bethlehem swiftly became one of its holiest sites. In 326, Helena, the mother of the first Christian emperor, Constantine, traveled to Bethlehem and shortly thereafter her son commissioned the construction of the original Church of the Nativity. (It was destroyed during a riot 200 years later, but was promptly rebuilt. The second version, finished in the mid-sixth century, still stands.) Helena's visit and a flow of imperial money sparked an influx of pilgrims, and soon there were dozens of monasteries in the nearby desert.

Then the Muslims arrived. Early in the seventh century, a merchant named Muhammad, living in Mecca in what is now Saudi Arabia, heard a voice he believed to be that of the angel Gabriel tell him, "Recite." Muhammad committed to memory the words that followed, and these revelations became the Koran, the Arabic word for "recitation." Within a century of Muhammad's death in 632, the religion he


SPORTS
SPORT
VICTORY



Idlers outnumber shoppers at a market in central Bethlehem, a town struggling with 50 percent unemployment. Travel restrictions have reduced job opportunities in Israel. Shipments of apples and other West Bank produce to Jerusalem have also fallen off.

founded—Islam—had spread throughout the Middle East.

For centuries Bethlehem remained a Christian island in a steadily expanding Muslim sea. Palestinian refugees from the 1948 war brought even more Muslims to the area, but Bethlehem remained a majority Christian town. Then, in 1967, Israel's victory once again altered the city's complexion. Jewish settlers began moving into the occupied West Bank; Christians, who'd started fleeing to safer lands during World War II, accelerated their exodus; and Palestinian militants initiated attacks on military and civilian targets. In the same region where Jews once battled Philistines, it was now Israelis against Palestinians. In 3,000 years, the only change, it appears, is a couple of syllables.

BEFORE ALL SEMBLANCE of normalcy was erased, the Al-Amal restaurant, just off Manger Square, was often filled with Jewish diners. They came for the falafel, seasoned with tahini and parsley, and the fresh *shawarma* sandwiches, the lamb meat tucked into a hot pita. Jews also came to shop in Bethlehem, known for producing the area's finest vegetables.

Settlements are designed to feel like safe, suburban oases, but they are not. The presence of settlers makes them targets.

But the Israeli occupation felt, to Palestinians, like a series of humiliations—a proud people reduced to dependency on their hated foe, at the mercy of Israel's military law, denied an airport, and forced to pay taxes to the occupation authority. In 1987, after two decades of such treatment, an intifada, or uprising, was launched (the word literally translates as "shaking off"). Young Palestinians hurled stones at Israeli tanks, a modern version of David and Goliath, with the roles reversed.

The intifada pushed the two sides to the bargaining table, and the Oslo Accords were signed in 1993. But both Israelis and Palestinians felt the provisions were not honored by the other side. In 2000, a second Palestinian uprising began, this one more brutal. Settlers were repeatedly targeted; suicide bombers struck with increasing frequency. Israeli forces shelled Palestinian towns, and settlers attacked Palestinian villagers and farmers. Two years later, the Israelis began building the barrier. Now, the only Jews who regularly enter Bethlehem are soldiers, in armored vehicles, weapons at the ready.

The owner of Al-Amal restaurant is a 53-year-old Muslim named Omar Shawrieh, a short man with a trimmed beard and eyes weighed down by heavy bags. The most prominent decoration in his restaurant is a martyr's poster: a curly-haired young boy in a light-blue polo shirt. "He's wearing his school uniform," says Shawrieh. It's his son.

Last fall, the Israeli army entered Manger Square on a mission to apprehend a wanted militant. The soldiers traveled in a large convoy—a dozen armored jeeps and a platoon of troops. It was early afternoon. Mohammed Shawrieh, 13 years old, stopped by his father's restaurant to get money for a haircut. The soldiers' presence sparked the usual commotion; several people began throwing rocks at them, then the violence escalated and shots were fired. Mohammed was curious, and he wandered across Manger Square. As soon as he noticed him missing, Omar panicked. "I ran to find my son," he says. "But they got to him before I got to him." Mohammed was shot in the side, a bullet piercing his liver. By the time he arrived at the hospital, he had bled to death.

The Israel Defense Forces acknowledge the boy was shot. "We were in the midst of a pinpoint operation, to arrest a most-wanted terrorist," says Aviv Feigel, a lieutenant colonel with the IDF. "It was very intense." Molotov cocktails and grenades, says Feigel, were launched at the soldiers. A few were injured. So they fired back. "Maybe that boy was just watching," says Feigel. "Or maybe he was participating. We didn't investigate. It's a complicated situation; it's not a classic battlefield. With them, everyone is in civilian clothes."



Residents of Beitar Illit, a fast-growing settlement of Orthodox Haredi Jews, shy from having their picture taken at a bus stop above town. Local traffic is limited to settlers and military, but residents still ride armored buses in case of a roadside attack.

Mohammed Shawrieh was buried the next day in a cemetery outside Bethlehem, in the shadow of an almond tree. This was followed by a demonstration and the wide distribution of his martyr's poster. Later, a plaque was placed at the spot he was shot, near the Church of the Nativity, just outside the crypts where bones of the children killed by King Herod, some 2,000 years ago, are believed to be kept.

The blame game is cyclical. Omar Shawrieh, of course, faults the heavy-handed tactics of the Israeli army; their quickness to shoot, their disregard for Palestinian lives.

The Israeli army says that if terrorists weren't trying to kill them, then soldiers would not have entered Manger Square in the first place. Since the start of the first intifada, more than 5,600 Palestinians and 1,200 Israelis have been killed.

Moderates do exist in the region, thousands of Jews, Muslims, and Christians who wish to forge bonds and work for peace. But the circumstances in Bethlehem are so fraught that even the most minor efforts—an Arab village attempting to sell produce to an Israeli town; the local Palestinian university trying to host a Jewish lecturer—are stymied by the ugly realities. Interactions between Palestinians and Israelis have mainly been reduced to brief exchanges at fortified checkpoints; often the Israeli soldiers are sealed inside bulletproof booths, the glass so thick the soldiers appear blurred.

No place harbors more frustration than the refugee camps, where families who were uprooted from their homes when Israel became a nation still live—generation after generation stuck in a stateless limbo. Ask where they're from, and they'll tell you the name of a town that's likely been erased from Israel's map, and speak in elegiac tones of its crystalline waters and verdant fields. Some display sets of rusty keys that once unlocked houses their parents or grandparents lived in before Israel existed.

"Everybody in camp hates the Jews," says 28-year-old Adel Faraj, the owner of a tiny shop in the Duheisha Camp, at the base of the Bethlehem hills. More than 10,000 people live in the camp's half-square-mile block. The camp's alleys, tight as slot canyons, are a collage of militant graffiti. Children run amid shattered glass. Sewage trickles down open gutters. At least





Feeling special, seven-year-old Ruchama Bedein dresses up for Passover dinner in the Efrat settlement. Her mother, Sara, like most settlers, believes Jews have a right to live on biblical lands in the West Bank and "walk the paths our ancient forefathers walked."

two suicide bombers have come from Duheisha, one of them a young woman.

Faraj sells toiletries and lamps and compact discs. He has a narrow face and curly hair, which he likes to gel, and expressive eyes canopied with dark brows. He keeps a water pipe, called a *narghile,* in his shop and smokes apple-flavored tobacco throughout the day. "If a Jew came walking into this camp, he'd be killed. With a rock. Or a knife. Or a gun. It doesn't matter who he was. A Jew is a Jew," says Faraj.

"My friend was a suicide bomber," he continues, exhaling, filling his store with smoke. Faraj's friend was Mohammad Daraghmeh, 18 years old, who blew himself up in March 2002 next to a synagogue in Jerusalem, killing 11, including two infants and a toddler in a stroller. As Faraj speaks, he puts a CD in his boombox. It's Bob Marley. The first track plays: "Is This Love?"

"I'm proud of him," says Faraj of his suicide bomber friend. "He did something great. The Israelis have forced us into this situation. They have left us with nothing. And when you have nothing, you have nothing to lose."

Moderates do exist who wish to work for peace. But circumstances are so fraught that even minor efforts are stymied by ugly realities.

AT TWO O'CLOCK in the morning most weekdays, several hundred men who do have something to lose—wives, children—begin lining up on the Bethlehem side of the wall. They're seeking work in Israel proper. They stand inside a long steel cage, like a cattle chute, waiting to be searched and prodded and fingerprinted and metal-detected. Some are told to strip. The process can take more than two hours. To be allowed through the checkpoint, you must be married and have one or more children. This, the Israeli army hopes, will ensure the laborers' return.

Many of the men are construction workers—often in the settlements. They wait in line for hours to build houses for their enemies on land that used to belong to them. They're paid $35 a day. Then they return home through the wall.

"Do you think we want to do this?" says one of the men, 35-year-old Sufian Sabateen. He holds a paper bag containing hummus and bread. He's smoking an L&M cigarette. His face, lit harshly by the klieg lights of the wall, is stoic. It's an hour before dawn. Sabateen insists he'd gladly work in Bethlehem for half the salary, but there are no jobs. This is how he describes his week: "From the mattress to work, from work to the mattress. My life is no life."

The wall, Palestinians say, suffocates an entire population for the actions of a small minority. They believe it is an Israeli attempt to establish a new national border, sealing onto the Israeli side all the choicest cuts from the land they occupied in 1967—the settlement areas, the scarce water sources, the fertile fields. The city of Bethlehem is being pinched into a seven-square-mile box, surrounded by a barrier on three sides.

As the wall continues to grow, giant digging machines, protected by armed guards, claw into the earth day and night. When completed, it will extend 450 miles, sometimes dipping as far as 15 miles into West Bank territory, claiming 10 percent of Palestinian land for Israeli settlers. The Israeli government says its goal is only to protect Israeli lives, not to redraw the border, and as soon as there's a sweeping shift in Palestinian policy toward Israel, the wall will be destroyed and the confiscated land returned. The Israeli government doesn't even call it a wall. It prefers the term "security fence," and in most places in the West Bank it is indeed a network of electrified chain-link fences and coils of barbed wire. But not in Bethlehem. The wall around much of Bethlehem is taller than the barriers used in Israeli prisons.

The Israeli government says the wall is working. The second intifada brought wave after wave of suicide bombings, striking throughout Israel, killing scores of civilians and soldiers. Starting in 2003, with construction of the wall proceeding at top speed, and with intensified military



Masked gunmen allied with Fatah march in Bethlehem to intimidate rivals from Hamas. Despite the show of force, the two Palestinian factions uneasily coexist here. Officially Israel negotiates only with Fatah, as Hamas does not recognize Israel's existence.

checkpoints, patrols, and intelligence, the number of attacks drastically declined. "Our life was hell," says Ronnie Shaked, an Israeli journalist. "Cafés were blowing up; buses were blowing up. But no longer. The wall is very important—it's protecting us. Thank God there is a wall."

But Palestinian leaders argue the wall has little to do with the reduction in suicide attacks. The bombings have stopped, they say, because the major militant groups, including Hamas, proclaimed a ban on them, in the hope of restarting peace talks. A concrete wall can't stop someone who's willing to die, many Palestinians say, and if militant groups wanted, they could send a suicide bomber into Jerusalem every hour of the day.

The most powerful politician in Bethlehem sees it another way. Salah Al-Tamari, the governor of the Bethlehem district, views the wall as a psychological ploy. "The Israelis want to provoke us; they want us to lose our minds," he says. "They want us to leave." The governor believes that the Israelis have purposely created such unlivable conditions in hopes that everyone will flee. Then they can have the land to themselves.

"Well, they can't have it," says Al-Tamari. He predicts the opposite will occur: The Israelis will eventually lose. The governor claims that simple demographics strongly favor the Palestinians. Muslim Palestinians on average have more children per family than Israeli Jews. "Their nuclear weapon," as one Israeli soldier puts it, "is the womb." By 2010 the number of Jews and Palestinians in Israel and the occupied territories will be about equal. After that, the Palestinians will have the majority.

"I will stay here, and my children will stay here," says Al-Tamari. "I'm a believer in the future. The wall will fall and the occupation will end—maybe in 10 years, maybe 50. We don't know when, but we do know one thing: We are staying here, on our land. No matter what."

BETHLEHEM MAY BE where Christianity began, but today its Christian residents are in a precarious spot. Israelis see them as Palestinian. Muslims see them as Christian. They see themselves, alternately, as lifesaving buffers or double-sided punching bags. Bernard Sabella, a Christian sociologist and member of the Palestinian



In the Aida refugee camp, a trash fire burns in rubble near the looming security wall. At least 12 suicide bombers have come from Bethlehem and its three crowded refugee camps, established to house Palestinians who lost homes in the 1948 Arab-Israeli war.



Prayer time comes as a Bethlehem family tends its vineyard before the wall divides their land. Behind them, ground has been cleared for the barrier, which will barricade the Efrat settlement (upper right) and further cement the divide between Israeli and Palestinian.

Parliament, says the Christian community may be all that's keeping the whole area from a blood-soaked implosion. The mere presence of Christians seems to reduce the scale of violence in the city: Israeli soldiers tread with caution around Christian holy sites. The last thing Israel needs is to incur the wrath of the world's Christians by damaging a revered church.

And yet Bethlehem's Christians feel increasingly like outsiders in their own city. Many dress in current Western fashion—tight jeans, plunging necklines, flashy jewelry. On Saturday nights, teenagers head to Cosmos, one of the only discos in the West Bank, where tequila shots are passed around and there is (somewhat) dirty dancing. Though some Muslims dress in modern styles, most Islamic women in Bethlehem wear head scarves, and others wear *jilbobs,* long, loose-fitting coverings designed to hide all curves. Drinking alcohol, for both sexes, is not acceptable in public. Social mingling between Christians and Muslims is infrequent, and interfaith marriages are almost nonexistent. Still, Christians and Muslims do work side by side at government offices, hospitals, schools, and charitable organizations.

At the checkpoints, Christians are treated like all other Bethlehem residents: with extreme suspicion. Even the mayor, Victor Batarseh—Bethlehem's mayor, by city ordinance, must be Christian—is not allowed to remain on the Israeli side of the wall past 7 p.m. "It's degrading," says Batarseh. "If I'm invited to cocktails in Jerusalem, I can't go because I don't have permission." He is 73 years old.

Bernard Sabella estimates that, because of the conflict, more than 3,000 Christians have fled in the past seven years. "It's not sheer numbers," says Sabella, "it's the type of people. Who is emigrating? The educated, the rich, the politically moderate, young families. Those who are best able to change the situation are leaving. Those who are unskilled, without education, or politically radical can't get visas."

"We are unable to survive here," says the patriarch of a Christian family who asked that their name not be mentioned. In Bethlehem, he says, the local government is essentially a puppet of the Israeli army—the police and the courts have little authority, a situation that affects all

residents, including Muslims. The real power in Bethlehem is controlled by extended families, and the most powerful clans are Muslim. Some in Bethlehem say privately they wish the Israelis would simply take over the city.

"Christians are afraid that if we speak frankly and Muslim families hear, we'll be persecuted," says the patriarch. "We'll be forced to pay a lot of money. And physical things, of course, are possible. Arson. Anything you can think of." His family lives in a *hosh,* a traditional group of houses built around a courtyard. They've been in Bethlehem so long they're mentioned in the Old Testament. They were here before Christ. "There's actually a Jewish branch of the family in Jerusalem," he says. "We separated about 2,000 years ago, when some of the family decided to follow Christ's teachings."

Now he's thinking of leaving. He has a sister in California and four brothers in Honduras. "Our family," he says, "will be entirely gone from the Holy Land for the first time since Christ. And I'll sell my hosh to Muslims. They'll consider it a victory—another one off the Christians! How can the Christian world accept this?"

Fifty years ago, there were just a handful of mosques in the Bethlehem district. Now there are close to a hundred. "My soul lives in Bethlehem," he says. "I'm like a fish—this is my water. Take me out, and I wither and die. But I'm afraid of the future. Can you imagine Bethlehem without any Christians? You better start imagining it, because in a few years, it might be reality."

The Christians themselves are not immune to infighting. Literally every square foot of the Church of the Nativity is battled over by the three sects that share use of the church: Greek Orthodox, Roman Catholic, and Armenian Orthodox. The holy men of the three denominations bicker over who gets to clean which sacred wall, who can walk in which aisle. The guards in the church, it sometimes seems, are not there to protect tourists but to keep priests from attacking each other. "Apart from Christ," says Father Ibrahim Faltas, a Franciscan friar who served in the Church of the Nativity for 12 years, "there have been few here who would turn the other cheek."

They can't even agree on Christmas in Bethlehem. What date is the holy day celebrated at the Church of the Nativity? The Greek Orthodox priests, who have a slight majority interest in the control of the church, rely for ecclesiastical purposes on the Julian calendar, which has a 13-day lag from the current Gregorian calendar. So their Christmas Mass is on January 6. The Bethlehem Christmas Eve service televised worldwide on December 24 actually takes place in the much newer St. Catherine's Church, run by the Roman Catholics, adjacent to the Church of the Nativity. And just to make things more complex, the Armenians celebrate Christmas in their wing of the church on January 18. So Christmas comes but thrice a year in Bethlehem.

But no matter your version of Christianity—or even if you're not religious at all—there seems to be something significant to the cave beneath the church floor, with its odor of incense and candle wax, lit by a string of bare bulbs. Visitors from all over the world descend the 14 steps into the earth. Many drop involuntarily to their knees. They pray, sing, weep, and faint at the Nativity spot. It happens all day, every day.

"I will stay here, and my children will stay," says Al-Tamari. "I'm a believer in the future. The wall will fall and the occupation will end."

The air in that grotto, dank and musty, has the smell of history. The conflicts played out in Bethlehem are capable of transcending borders—the future of millions of people, after all, is at stake. A major breakdown could engulf much of the globe. "It's easy to think of Bethlehem as the center of the world," says Mayor Batarseh. "This can't be a place where calm never exists. If the world is ever going to have peace, it has to start right here." □

Turbulent Town Photographer Christopher Anderson narrates the stories behind his Bethlehem images at **ngm.com.**

Precisely fitting the curve and camber of eight-foot-long wings to the shape of storm winds blustering along the New Zealand coast, a Salvin's albatross glides, at one with the sky. Ahead lie daunting challenges to its survival, many of them human-made.



ALBA



ON THE WINGS OF THE TROSS



Like teenagers at a mall, young southern royal albatrosses socialize on New Zealand's Campbell Island. After big males show off, females take their turn, displaying long, slender wings. These birds won't begin breeding for three to nine more years, but time spent "hanging out" is crucial to selecting a mate—for life.

BY CARL SAFINA

PHOTOGRAPHS BY
FRANS LANTING

An albatross is the grandest living flying machine on Earth. An albatross is bone, feathers, muscle, and the wind. An albatross is its own taut longbow, the breeze its bowstring, propelling its projectile body. An albatross is an art deco bird, striking of pattern, clean of line, epic in travels, heroically faithful. A parent albatross may fly more than 10,000 miles to deliver one meal to its chick. Wielding the longest wings in nature—up to eleven and a half feet—albatrosses can glide hundreds of miles without flapping, crossing ocean basins, circumnavigating the globe. A 50-year-old albatross has flown, at least, 3.7 million miles.

If people know the albatross at all, most harbor vague impressions of an ungainly, burdensome creature, derived from Samuel Taylor Coleridge's 1798 poem, *The Rime of the Ancient Mariner.* Turns out, Coleridge never saw an albatross. Also turns out, most people haven't read the poem. In the poem, the albatross benevolently fills the ship's sails with wind and aids its progress. When the mariner impulsively kills the albatross, horror grips the crew; they punish the mariner by making him wear the great corpse around his neck.

But let's not burden albatrosses with our metaphors. Doing so, we fail to see the real birds, which connect us to what's happening in the seas in ways many of us can scarcely imagine.

If you could travel millions of miles fueled by clean, self-renewing, zero-emissions energy, you'd be an albatross. Strictly speaking, albatrosses are mediocre fliers—but excellent gliders. They can lock their wings in the open position like switchblades, the bird merely piloting the glider it inhabits. Catching the wind in their wings and sailing upward, then

His presence accepted by a black-browed albatross in the Falkland Islands, photographer Frans Lanting waited for hours to capture a single frame that would represent the shared work of mates—nesting on shore, and foraging on the wing.

harnessing gravity while planing seaward, they travel in long undulations. Most birds struggle to overcome wind; albatrosses exploit it.

What differentiates an albatross from, say, a gull, is not just architecture but also state of mind, a brain that is master navigator of so exquisite a body. Swap the software, install a gull brain at the helm of an albatross, and the great vital sailing craft would never dream of daring the distances that an albatross routinely conquers. Gulls hug the shores and proclaim themselves monarchs of dock pilings. Albatrosses cross oceans for breakfast and deign to touch shore only when it involves sex. Land is an inconvenient necessity for breeding.

Granted, on land—where they seldom are—albatrosses walk with a spatula-footed, head-wagging waddle. Walking isn't their thing; no one will ever film *March of the Albatrosses.* But oh, when they unfurl those wings and leave gravity to the rest of us, they become magnificent beyond the reach of words.

Graceful as angels and tough as leather, all albatrosses—about two dozen species—spend months and sometimes years beyond sight of land, able to take the most hellacious punishment the ocean can hurl. While living in the windiest regions on Earth, they seem to inhabit another plane of existence. Writing home from the South Atlantic to his new wife, Grace, in 1912, American ornithologist Robert Cushman Murphy exulted, "I now belong to a higher cult of mortals, for I have seen the albatross!"

The places of albatrosses are beyond the inhabited limits of humanity, on spare, elemental islands that feel like the center of a water-bound planet. Yet humans touch them in all their haunts. As a result, almost all albatross populations have declined significantly in recent decades. I sought out the densest, most populous remaining albatross colonies in the world. Everywhere, I encountered threats to the birds, but also people working to blunt those threats. To restore their numbers, we need to offer albatrosses a new truce. Otherwise, they'll have to find another world, and even albatross wings can't get them there.

AT 51° SOUTH LATITUDE, the bare shoulders of the Falklands' Steeple Jason Island shrug gracefully toward a coast wreathed with emerald, head-high tussock grass. Walk around the island's north end and behold a living spectacle: Black-browed albatrosses so crowd the ledges and shoreline, the birds are the shoreline. This main colony runs two and a half miles.

The birds' softball-size heads are slashed with signature black brow stripes above dark eyes. Their four-inch bills are airbrushed tones from pastel mustard to translucent pink to a rosy blush at the hooked tip. Dusky-billed adolescents that have lived at sea four or five years are back on solid land for the first time. It's the season for courtship. The youngest ones are trying out moves, like 14-year-olds at the mall. Long-term relationships appear unlikely. But valuable social skills accrue. Like Kabuki dancers, they show off in exaggerated movements, turning preening into choreography, fanning tails, cooing, mutually extending their necks and laying bills together. They accentuate flawless wings, healthy plumage, and attentive grooming the way young teenagers accentuate skin and vigor, displaying precisely those body parts that indicate fertility.

Many of the adolescents seem decidedly undecided about which they fancy. But fickleness is actually a critical assessment for a momentous decision: A bird's choice of mate largely determines whether its chick survives. Raising a chick requires both parents, so courtship often spans two years. Those in advanced courtship sit long intervals in close contact, tenderly preening each other's heads and necks. This reinforces reliability and mutual care. Thus they

Carl Safina's books include Eye of the Albatross *and* Song for the Blue Ocean. *Wildlife photographer and conservationist Frans Lanting is the author of numerous books, including, most recently,* Life: A Journey Through Time.

begin a lifelong bond that will keep the wheel of life in motion.

Each sweep of vision takes in hundreds of commuting birds—but scarcely a flapping wing. Wind powers this mass-transit system. Many hurtle downwind; those going upwind weave into the air currents, catching the crosswind and sailing upward with their bellies windward, then turning downward into the breeze. Masterfully playing these two great forces of wind and gravity, they make near-effortless progress.

The same engine of air that motorizes the birds delivers weather systems ashore in great passions of glorious sunshine, stinging hail squalls, and snow-laced gales. You might see blue sky to the horizon and in a few minutes be enveloped in horizontally driven rain under a drop curtain of blue-gray cloud that seems infinite—until a few minutes later when the sun again bursts through. Whirling williwaws blast sheets of water off the ocean, sending shattered shards of spray. Fifty-mile-an-hour gusts take your breath away. The birds experience it with a stoicism unavailable to humans; they have no cover and must find refuge within themselves.

But strong as they are, Falklands albatrosses run into trouble with fishing boats off Argentina, Uruguay, and Brazil. Knowledge of their decline shadows the rhapsody I feel. In the softening light on my last Steeple Jason evening, I slowly perch next to a bird. It bows as if we're to start courting. I extend my hand. It reaches out, gently nibbling my finger. Mimicking what I'd seen courting birds do, I slide my finger alongside its bill and stroke its cheek.



ALBATROSSES LIVE on thin margins. Working hard to wrest a living from the sea, they cannot amass enough energy to lay more than one egg in a breeding season. Royal albatrosses require a year to raise a chick, an effort that leaves adults so depleted they skip a year of breeding to molt and regain weight.

Campbell Island, where the southern royal albatross nests, lies *(Continued on page 104)*

WORKING HARD TO WREST A LIVING
from the sea, they cannot amass enough energy to
lay more than one egg in a breeding season.



By the hundreds of thousands, black-browed albatrosses come to Steeple Jason Island to build mud-pillar nests and raise the next generation of their kind. Some 399,000 pairs, two-thirds of the world's black-brows, breed here in the Falklands. But colonies have shrunk alarmingly. So many birds have died in longline and trawl fisheries in the southern oceans that in 2003 the International Union for the Conservation of Nature declared the species endangered worldwide.

OCEAN WANDERERS

Built to glide at high speed, an albatross masters the wind to spend most of its life aloft at sea, coming to shore only to breed. Tracking is revealing the routes of these marathon travelers.

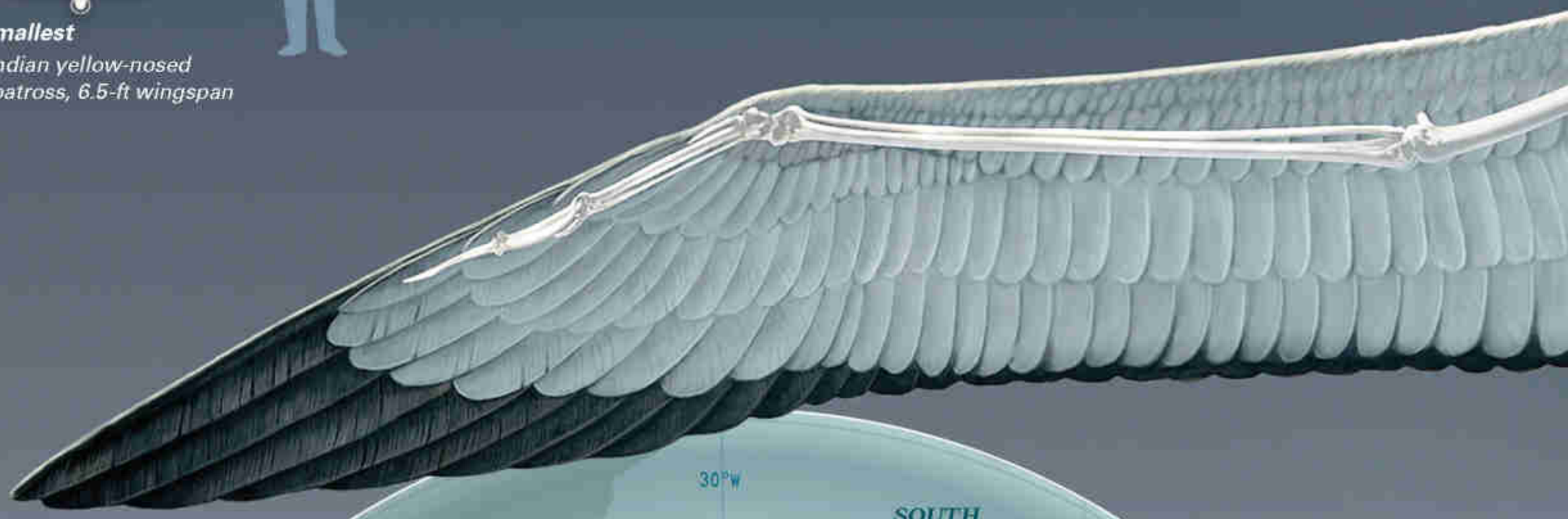


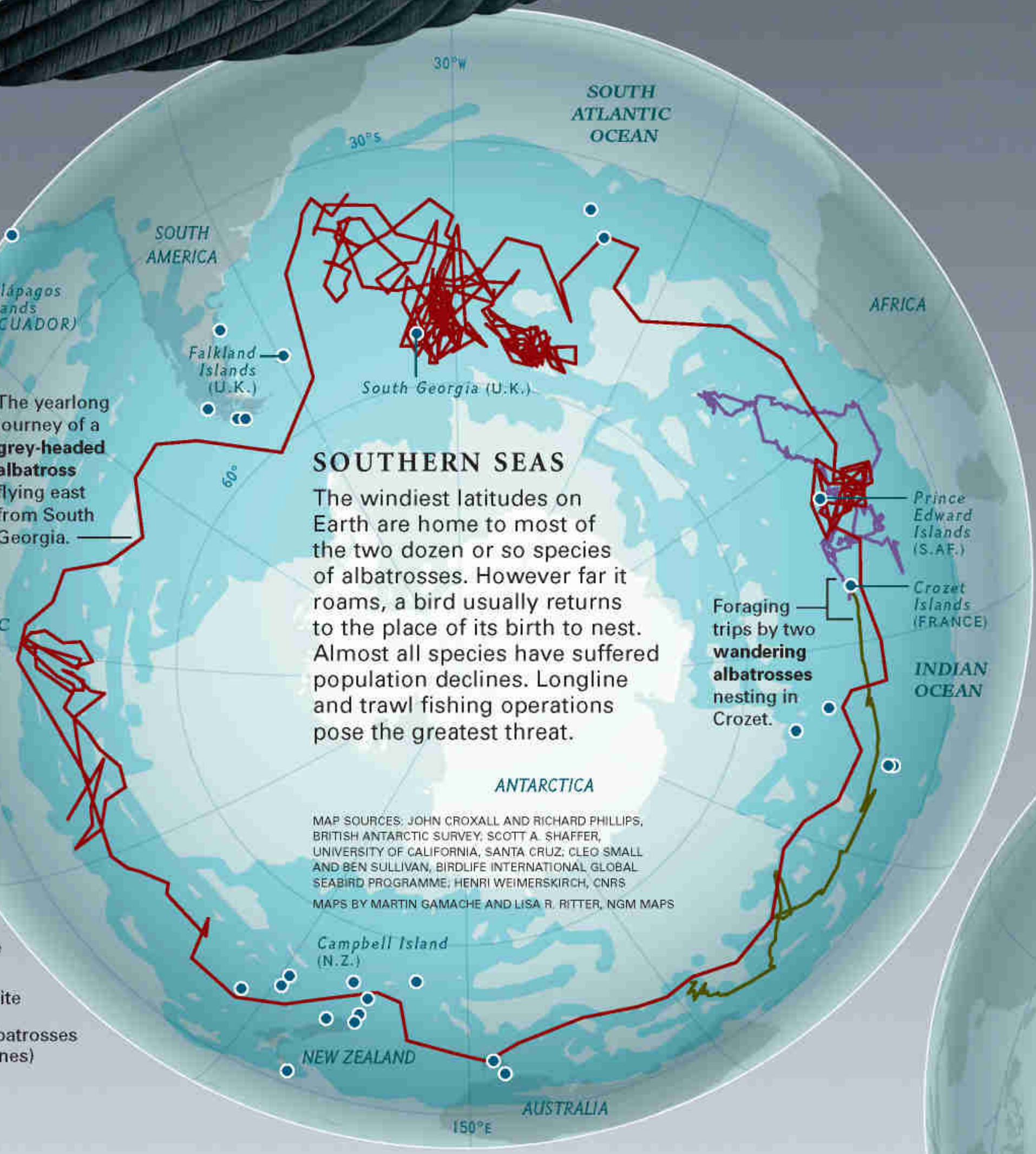
Biggest albatrosses

• Wandering and southern royal, up to 11.5-ft wingspan

Smallest

• Indian yellow-nosed albatross, 6.5-ft wingspan





The yearlong journey of a **grey-headed albatross** flying east from South Georgia.

Foraging trips by two **wandering albatrosses** nesting in Crozet.

SOUTHERN SEAS

The windiest latitudes on Earth are home to most of the two dozen or so species of albatrosses. However far it roams, a bird usually returns to the place of its birth to nest. Almost all species have suffered population declines. Longline and trawl fishing operations pose the greatest threat.

MAP SOURCES: JOHN CROXALL AND RICHARD PHILLIPS, BRITISH ANTARCTIC SURVEY; SCOTT A. SHAFFER, UNIVERSITY OF CALIFORNIA, SANTA CRUZ; CLEO SMALL AND BEN SULLIVAN, BIRDLIFE INTERNATIONAL GLOBAL SEABIRD PROGRAMME; HENRI WEIMERSKIRCH, CNRS

MAPS BY MARTIN GAMACHE AND LISA R. RITTER, NGM MAPS

Range (based on satellite tracking)

Breeding site

Tracked albatrosses (all color lines)

1

2

3

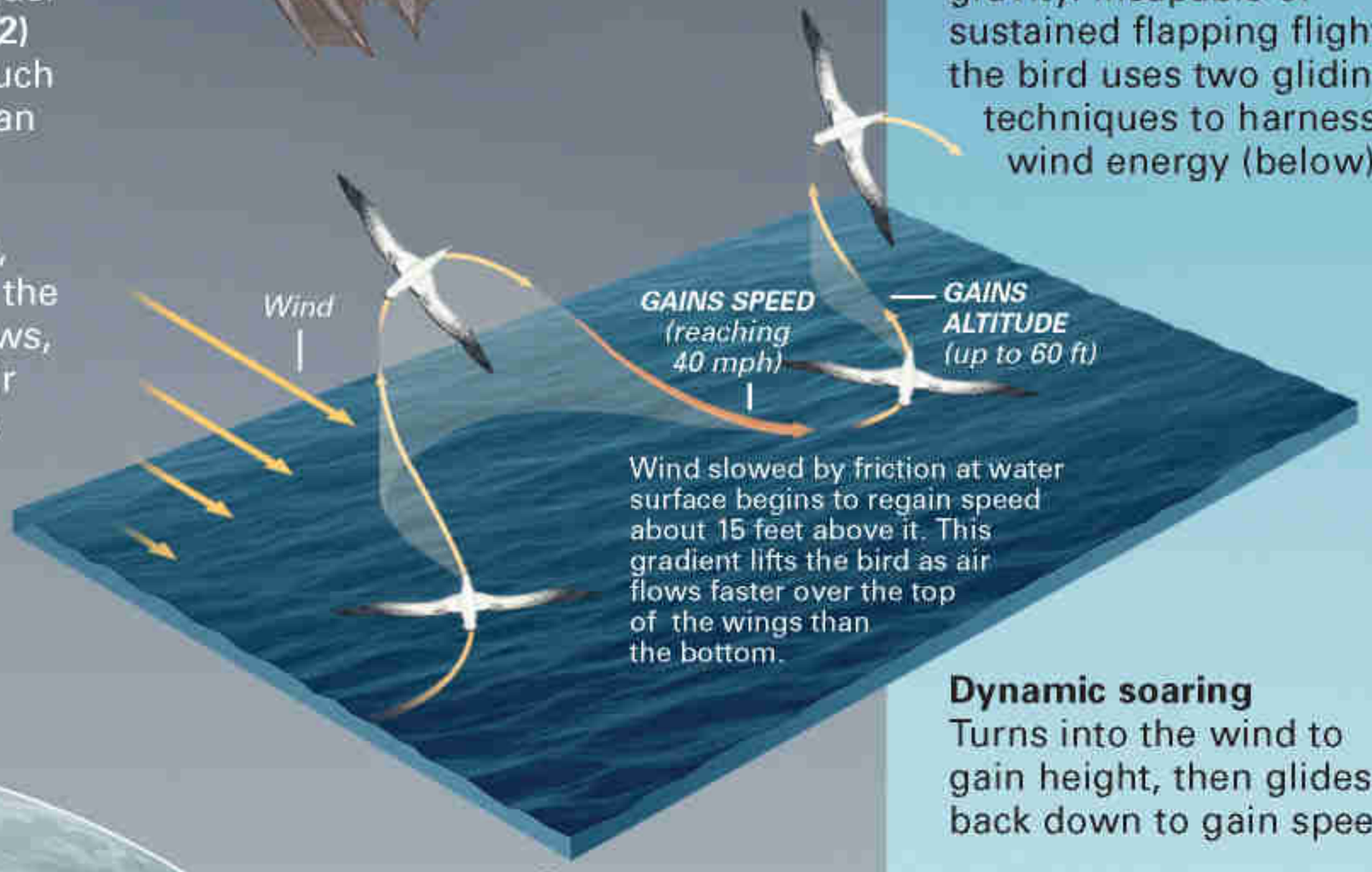
4

FLYING MACHINE

A wandering albatross (above) and kin travel hundreds of miles without muscle fatigue: Unfurled wings are locked into place by a tendon running between shoulder and elbow joints **(1)**. Muscles **(2)** are strong but account for a much lower portion of body mass than in birds that rely on flapping. Internal struts reinforce light, hollow bones **(3)**. Like all birds, it doesn't draw air directly into the lungs; air sacs **(4)** act like bellows, filling then deflating to force air through the lungs, maximizing oxygen exchange.

WIND RIDERS

Gliding efficiency can carry an albatross 20 feet forward for every foot it drops due to gravity. Incapable of sustained flapping flight, the bird uses two gliding techniques to harness wind energy (below).



Dynamic soaring
Turns into the wind to gain height, then glides back down to gain speed.

Slope soaring
Wind rising over wave fronts provides lift.

PACIFIC OCEAN

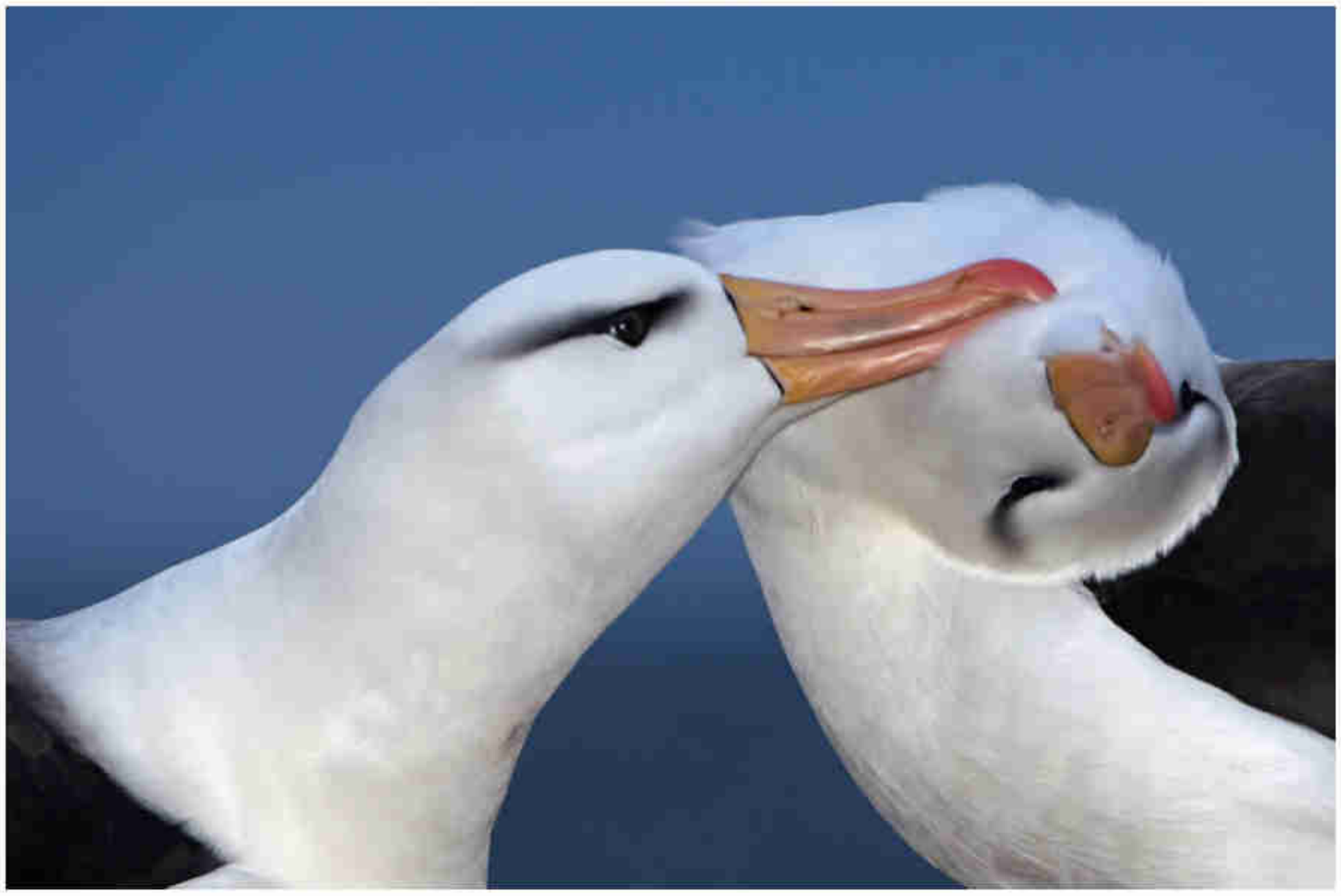
Four species inhabit the northern and central Pacific. Nesting on Tern Island, Laysan pairs take turns feeding at sea on trips that tracking shows last from 10 to 30 days.



ART SOURCES: TERRY BROWN, MUSEUM PROFESSIONALS INC.; BURKE MUSEUM, UNIVERSITY OF WASHINGTON; FIELD MUSEUM OF NATURAL HISTORY; UNIVERSITY OF IOWA MUSEUM OF NATURAL HISTORY

ALBATROSS ART BY RAÚL MARTÍN; REPORTED BY BRENNA MALONEY; DESIGN BY JUAN VELASCO, NGM ART

Awkward on land, North Pacific albatrosses like this Laysan are called "gooney birds." But University of California researcher Scott Shaffer, who's tracked birds flying at 70 to 80 miles an hour, says "there's nothing 'gooney' about them in the air. They're astounding."







ALBATROSSES CROSS OCEANS FOR BREAKFAST
and deign to touch shore only when it involves sex.
Land is an inconvenient necessity for breeding.



It begins with a bow. Then a gaze. Then they rise as on tiptoe, beak to beak. The dance goes on, intimate, noisy, a tango, but with squawking. Black-footed albatrosses like this male (above, at right) and female on Tern Island, both banded for research, may meet to dance and work on nest construction for several seasons before breeding, nurturing a bond that can last 20 years or more. Less formal gestures matter too. In the Falklands a female black-browed albatross (facing page, at right) yields her throat to her mate's nibbles, and offers a graceful beak-stroke of her own. Elaborate courtship isn't limited to these birds—all species of albatrosses work hard to keep the romance alive.

Gale-force winds churn the South Atlantic into heaving breakers and twist the sky into a roller coaster. Rising on air currents deflected off the waves then swooping back to the surface, albatrosses have been satellite-tracked traveling more than 500 miles in a single day.



Seabirds do a lot for their offspring, even predigesting their meals. Prey are reduced to a stream of oily, calorie- and nutrient-dense fluid, then regurgitated directly down a chick's throat (above). In a mixed New Zealand colony of grey-headed and Campbell albatrosses (right), chicks shelter under a guardian parent for the first three to four weeks of life. By the time they're left alone, bigger chicks can protect themselves from marauding skuas (right, at top) and other hazards.

(Continued from page 94) 400 miles south of New Zealand, a place of mountainous waves and monstrous birds. New Zealand is Albatross Central, and over the crests and troughs sail white-capped, Salvin's, Buller's, royal, and wandering albatrosses, plus giant petrels, shearwaters, and companionable pintado petrels, whose markings make them look like flying dominoes. High cliffs and explosive surf guard Campbell Island's loneliness. A chilly wind blows perpetually. The list of species breeding here underscores New Zealand's albatross primacy: the Campbell albatross (found only here), grey-headed and light-mantled sooty albatrosses, a few antipodean wanderers and black-brows.

Campbell Island has no vehicles. Time and distance shift to the rhythm of your legs. The most direct route to the birds entails a 45-minute walk over a 500-foot ridge. Peter Moore, a biologist at New Zealand's Department of Conservation, and I find the great birds in a broad valley. Across the wide distance, my mind undercalibrates their size, until one swoops close and Moore is suddenly dwarfed by a bird whose wings are far longer than the tallest person on Earth. No bird has longer wings than a southern royal albatross. At eleven and a half feet tip-to-tip, they shred the air around them, whooshing like small jets. On the ground the birds look like huge porcelain statues.

At the moment, they're incubating eggs. Most doze upon grassy nests, their heads tucked into snowy underwings, the dense feathers on their backs blowing in the wind.

Moore checks leg bands and applies new ones so gently that each bird remains sitting tight on its egg. The birds nibble his fingers with their sharp-hooked bills. The birds impart to these







Takeoff is hard work for an albatross, especially for a fledgling making its first attempts at flight (above). Exhausted wings drooping in Midway Atoll shallows, another fledgling (right) seems to admit defeat, for now. Still downy, their feathers not fully developed, these Laysan albatrosses may have declared independence too soon, Scott Shaffer says. "Young birds have to learn to forage and navigate all on their own, and many of them die before they master the skills they need on the open sea."

lonely slopes a magic disproportionate to the facts of the grass, the distant ocean, and a few big birds.

Despite Campbell's isolation, rats arrived with seal hunters in the 1800s; would-be farmers arrived around 1900. Everything they brought—grasses, sheep, cattle, fires, dogs—was bad for albatrosses. They called albatross eggs "good to eat too, bigger than a goose egg." When the settlers left, around 1930, perhaps as few as 650 pairs of royals remained. Rats devastated nearly everything else. Since the Department of Conservation's 2001 rat eradication, smaller seabirds, snipes, Campbell Island teal, insects, and flowering herbs are returning from offshore islets. Southern royal albatross numbers rose to about 13,000 breeding pairs by the mid-1990s. But something has held them to that level. In a lovely nest an abandoned one-pound egg indicates a lost partner, plus a mate forced by hunger to abandon its effort. Cause unknown.

Albatrosses' siren-like beauty has tempted me to some of the loveliest and loneliest places on the planet—and today into a punishing gale. Its gusts threaten our planned six-hour hike to the island's north end and its dense colonies of Campbell and grey-headed albatrosses. In these latitudes, wind can sweep right around the bottom of the world, then come in body blows to punch you off your feet. Gusts repeatedly flatten us. Against one blast I plant my walking stick yet am catapulted right over it. Never has hiking left me so beat up. But albatrosses love wind, and I love albatrosses, so. . . .

When we reach the north cliffs under skies thickened with clouds, thousands of large birds glide through sun shafts between the low-crouching heavens and the pewter sea. The



air carries their raucous braying and the not-unpleasant scent of guano. Mud-pedestal nests packed pecking-distance apart are topped by month-old chicks that sit upright like foot-tall snowmen. I watch as adults arrive to feed them. Parent albatrosses convert food into high-density oil with a caloric content that's been compared to diesel fuel. When a parent arrives, it and the chick excitedly position their bills crosswise. Then the adult squirts a stream of oil as if filling a tank. An adult may spend 15 minutes ashore feeding its youngster a meal that's a third the chick's body weight, then leave again for another trek of several weeks and thousands of miles. Between feedings, the chick converts oil into bone, flesh, and feathers. The chick grows so much between visits that adults recognize them not by sight, but by voice or scent.

I linger for hours, drinking in the action and spectacle, knowing that while the scene seems eternal, my own wanderings urge me onward. I too have miles to go across the deep.

IT'S GRADUATION DAY at Midway Atoll, near the northwestern end of the Hawaiian archipelago. With only 2.3 square miles of land, Midway Atoll National Wildlife Refuge hosts the world's largest albatross colony—nearly half a million pairs. (In 1909, responding to Japanese plume hunters killing albatrosses by the tens of thousands, President Theodore Roosevelt declared many of the surrounding islands a bird reservation—enforced by gunship—and saved North Pacific albatrosses from extinction.) Some islands still lie silent of albatross voice. But at Midway, now refuge headquarters, it's albatrosses, albatrosses everywhere: under the trees, all over the lawns, in doorways, on steps, at the dining hall doors.



Elegance aloft turns to frenzied competition at feeding time: Bait helped Frans Lanting lure a scrum of birds, including both albatrosses and petrels—closely related seabirds—to alight on rolling seas off New Zealand's Kaikoura Peninsula.

THERE'S PROGRESS ELSEWHERE, TOO.

In Falklands waters, a single boat might kill as many as 140 birds in one day—until recently.

First light unveils a shore thronged with hundreds of thousands of young albatrosses poised momentously between hatchlinghood and their flying lives. At this critical transition, many are on the knife-edge of life and death. Corpses of goose-size chicks litter the island. A few have wing deformities, likely from eating lead paint flaked from buildings. Hideously, the body cavities of many dead chicks contain cigarette lighters and other discarded plastic their parents swallowed at sea and fed to them. Some have starved. Others succumbed to heat.

Yet survivors dominate. They're big youngsters sporting downy remnants around their heads like lion's manes or Mohawks. Whenever a breeze sweeps through, these juveniles begin flapping. If it's very windy, entire fields of albatrosses wave their wings in the air, testing them. Eventually the birds will begin running the beaches until the slap, slap, slap sound of running feet ends with hard-earned airborne silence. Initial flights are short. Above the laboring juveniles sail adults whose effortless speed and grace indicate a concept perfected.

Yet today there's not a bee's buzz of breeze to loft them. Well, if the wind won't take them, their feet will. Hungering for the horizon, the birds simply walk into the water, wings hoisted like sails, paddling across the lagoon. For hours, more venture across the turquoise calm until an albatross armada stretches out of sight.

Each breathless dawn sees wave after wave of young albatrosses step out of the vegetation and paddle away. About 13,000 are leaving daily. It is *March of the Albatrosses*!

Where are they going? Biologist John Klavitter pilots our boat over the lagoon. Scanning with binoculars, we realize that at the point where the lagoon's mirror breaks into a million shimmering shards of sunlight sit albatrosses by the tens of thousands. The water is soupy with birds. While thousands sit bobbing, hundreds are trying the sea breeze. Their youthful excitement is infectious. But most of the birds seem afraid to cross the surf. Some fly straight at the ocean, then U-turn over the breakers and veer back into the lagoon.

It's high drama in slow motion. If they stay, they starve. Doldrums are costly. All the paddling and flapping has debited their energy accounts. But enough young albatrosses are flying outside the reef, over the deep cobalt swells, to show that birds are slowly suffusing into the open North Pacific, their true home. They've earned their wings.

For the next couple of months, the crucial task is finding food enough to survive. Studies in the Indian Ocean suggest young albatrosses suffer about 40 percent mortality in the first two months post-fledging. How they learn to forage —do they watch experienced older birds?—no one knows. We do know that while albatrosses eat mostly squid, they often gather around fishing boats, waiting for food in the form of scraps, guts—and baited hooks.

IF YOU KILL AN ALBATROSS you are not forced to wear it, nor will it doom your ship. But nowadays every albatross has humanity around its neck. "There are optimists and there are worriers," says Beth Flint, a biologist at the United States Fish and Wildlife Service. "My job is to worry about albatrosses. A hundred thousand drown in fishing gear every year. They're the world's most threatened family of birds."

The Falklands' black-browed albatrosses have lost about 38,000 pairs in the past decade. Nic Huin, a soft-spoken, heavy-smoking French scientist with Falklands Conservation, calculates they've been declining one percent annually. Among the throngs, that one percent doesn't seem like much—until you realize 38,000 pairs is nearly one adult bird every two hours. One percent is like a giant invisible eraser that could, over time, wipe away every bird in view.

In 1988, Australian conservation biologist Nigel Brothers first linked fishing boats with the albatross declines scientists were reporting. The birds trail boats deploying longlines—up to 50 or so miles long—with thousands of baited hooks. If

RISKS OF A LIFE AT SEA



Masses of plastic debris float in the Pacific, looking like food to seabirds. A Laysan adult spits out a blue jar lid—a potentially fatal meal for its chick (left). But strategies exist to help reduce the hazards humans create for albatrosses. Bright pennants fluttering on bird-scaring lines (below) keep even hungry albatrosses away from the deadly nets and hooks of commercial fishing vessels. Such low-cost efforts can cut the number of seabirds killed—estimated at 300,000 each year.



SARAH CROFTS, FALKLANDS CONSERVATION

ALBATROSSES CAN WANDER TO THE ENDS
of the Earth. Each of us can help ensure
they never go farther than that.

hooked while trying to steal the bait before the line sinks, they drown. Albatrosses also crowd behind vessels dragging trawl nets, where slicing cables can strike their long wings. Free lunch it isn't; albatrosses get killed faster than they can breed.

Brothers has worked on the problem with fishermen, surviving fire at sea and a vessel sinking. "Fishing is hard, monotonous work; thousands of hooks baited, deployed, and hauled per day," he says. "If fishermen have to do something extra to save a bird or a turtle—if they don't have an easy option that costs nothing—it won't happen. You have to make conservation easy." They have. Brothers and Eric Gilman, of the Blue Ocean Institute, are collaborating with fishermen to simply add weight to the lines and set them from the side of the boat instead of from the back. With side-setting, baits sink beneath the hull, out of birds' reach. Other measures include dyeing bait dark blue and setting lines at night.

The result: Over the past ten years the Hawaiian fleet's kill of all seabirds dropped 97 percent. "But Hawaii's efforts won't be enough," Brothers says. He's seeking worldwide standards for longlines. Weighting lines would probably fix 80 percent of the problem.

There's progress elsewhere, too. In Falklands waters, a single boat might kill as many as 140 birds in one day—until recently. Now longliners and trawl netters must use bird-avoidance measures such as "streamer lines" and "bird curtains," which dangle from the boat and prevent birds from getting at baited hooks or colliding with net cables. Over the past few years, bird kills there dropped 99 percent for long-liners. In much of the vast circumpolar Southern Ocean, longline bird kills in areas managed under the 24-nation Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) declined from 6,589 in 1997 to just two in 2006.

These numbers don't account for many boats fishing illegally, or in areas not covered under CCAMLR. Albatrosses circumnavigating the world still interact with many boats unconcerned about birds or law. Some fishermen have even been known to catch albatrosses for food.

What the successes do show is what's now possible. Groups such as Southern Seabird Solutions, BirdLife International, and Brazil's Projeto Albatroz are also working hard with fishermen to close the gaps.

But fishermen aren't the only ones who can improve things. Seafood lovers' choices decide what fish will get caught and what fishing methods will find market favor. Consumers can help by being selective. For instance, because Patagonian toothfish ("Chilean sea bass") is heavily fished and some is caught illegally, most conservation groups recommend avoiding this fish, since it's hard to tell where it's coming from. But South Georgia's Chilean sea bass fishery is well managed, and the Marine Stewardship Council (MSC) now rates it as sustainable after managers there tackled the seabird problem. (In the U.S. you can find it at Whole Foods Market and elsewhere—just be sure you see the MSC logo on the package.)

Sean Martin, whose Honolulu company Pacific Ocean Producers operates and services fishing vessels, says, "If environmentalists publicize a problem, the whole industry gets a bad reputation. So if we develop a way of keeping birds off our bait and we're doing it profitably, other countries take note. We can go to a fisheries conference and say, 'Look folks, we're doing all this stuff and we're still making money, and keeping the environmentalists' heat off us all.'"

Albatrosses helped save Ernest Shackleton during his heroic lifeboat trek to South Georgia Island to summon rescue for his stranded crew. The first thing they did upon landing was to stew some fledglings. Albatrosses now need us to save them. Albatrosses can wander to the ends of the Earth. Each of us can help ensure they never go farther than that. □

Fly Like an Albatross Get a bird's-eye view of elaborate albatross greeting and courtship rituals, and explore how these birds are able to fly so efficiently in an interactive graphic at **ngm.com**.

A southern royal albatross tilts its 11-foot wings and hurtles along a Campbell Island ridgetop. "It lifts your soul," says New Zealand scientist Peter Moore, "and makes you glad to be alive to see these magnificent creatures in their natural home."

21st-Century Cowboys

Why the Spirit Endures

BY ROBERT DRAPER

PHOTOGRAPHS BY ROBB KENDRICK

Captured in a tintype photograph that evokes the spirit of the Old West, Colter Schlosser's gear mixes style with utility. "If it's not functionable, it's not worth wearing," says the British Columbia buckaroo, 17. A flat-brimmed hat blocks the sun, leather cuffs prevent brush burns, and fringed half chaps deflect the rain.





A cowboy's day begins in the corral, roping a horse and saddling up at first light. His mount is his partner as well as his transport. "You're a team," says buckaroo Clint Damewood, in the black hat, at the historic ZX Ranch in Oregon. "When you're chasing cows around out there, it's just you and him."





There are two things that Wes Miner hopes not to see when he wakes early each morning and saddles up to survey the cattle left in his care. He does not wish to see a big black bird. Miner has nothing against crows or buzzards per se. But to view them wheeling solemnly across the sky, or scattering from the brush at his approach, is to feel his stomach tighten as he reckons with the knowledge that one or more of the animals entrusted to him have been killed.

Some of them are freak deaths. Four years ago, Miner worked on a ranch in Idaho where a spectacular electrical storm had erupted and toppled a dozen head of cattle huddled under a tree. Their bleached bones remained arrayed on the pasture for years as a testament to ill fortune. On the ranch he now tends in southwestern Montana, wolves devour a calf in the dark of night and leave no trace of the carnage. A cow gets stuck in a bog, breaks her leg, and Miner is forced to shoot her on the spot. A yearling munches on the blossoms of poisonous larkspur and drops dead within four hours. Nature gives and snatches away on a whim, but Wes Miner can handle that.

"What gets to me," says the 28-year-old somber-eyed cowboy, "is if we lose a bunch of sick ones. Because that's something I should control better." Men in Wes Miner's trade love the riding, the roping, and the stark romanticism of a cow camp. But there is a bottom line, and it comes at the end of October, when the 4,100 head he is paid to tend are herded into corrals, and the cattle owners roll up in their dusty pickups to count and inspect their property.

In high country like the Snowline Ranch where Miner works, temperatures can seesaw from 80 to 8 in a single day, and so pneumonia is a constant threat. It occupies Miner's attention as he rides through the cattle. If some of them get caught in a downpour during cold weather, he's fatally behind the curve. He must seize upon the earliest symptom: that lone calf amid the lurching sea of fur and fat with a single drooping ear, at which point Miner's horse separates the calf from the others and the cowboy swings his long rope. Catch the calf with the first loop, reach for the meds in the saddlebag, inject the Nuflor. Done right, the calf barely notices, returns to the herd, and by the end of October is 600 pounds and received by his owner with an approving half smile—which to Wes Miner is a tiny miracle, at least compared with the sickly vision of the big black birds dining off his failures.

It's a proud feeling, knowing he has staved off tragedy and been rewarded with the gratitude of owners who wave goodbye as they cart off their fattened commodities. The satisfaction lasts an evening. The next morning comes, and with it Wes Miner faces the second spectacle that he would rather not see. It's the sight of a pasture

Beau and Rowdy Hall play basketball, swim, and snowboard, but cowboying on Colorado's North Pueblo Ranch alongside their father is the most fun of all. "They're more help than some of the grown-ups he's hired," says their mother.

with no cattle grazing on it. And this, too, feels like a sort of death. "We go so hard those last two or three weeks—every day, go, go, GO . . . and then you look on the hills, and there's nothing but those saddle horses. It's an empty feeling."

AMERICAN COWBOYS have not vanished in the mists of legend. Against the howling locomotion of modern and postmodern and transmodern eras, they reside right where they have been for three centuries and counting: in the cattle country of the West and Southwest, and at the core of a nation's identity. This, despite the vagueness of the vocation itself. Are there ten thousand working cowboys today? Fifty thousand? Even were everyone to agree on the definition of "working cowboy"—and good luck with that—tracking the species has eluded every organization from the Working Ranch Cowboys Association to the United States Census Bureau.

Whatever the actual number, the job itself has gotten no easier in recent times. As cattle ranching has increasingly become big business, the cowboy's essential place is more subject to an accountant's dispassionate scrutiny. For that matter, the 71-billion-dollar U.S. cattle industry itself is beset by challenges from changing weather patterns, the vagaries of the international market, urban sprawl, and health threats from abroad. Inevitably, some cattle operations have learned to diversify by leasing out their acreage to hunters or offering dude-ranch tourism. Computerization—for ear-tagging and brand recording, among other uses—has increasingly become a welcome if strange bedfellow on cattle ranches.

Robert Draper, a former staff writer at Texas Monthly, *passed childhood summers on a quarter-horse ranch. Robb Kendrick spent six months documenting cowboy life in tintypes, a 19th-century photographic process.*

But if high technology is the unstoppable force, here is the immovable object: Cattle subsist largely on grass. Cows need to be led to where the grass is ample. To achieve that requires no more and no less than an individual on horseback, accompanied by a rope and maybe a decent stock dog or two—all set on a landscape detached from urban clamor, not to mention cell phone service.

Proof of the cowboy's resilience is that he has survived Hollywood's ceaseless hyping of him as the quintessence of terse, masculine individuality. In the romanticizing, a few details are overlooked: Subzero February mornings. Triple-digit August afternoons. Cracked ribs from being bucked off a spooked horse. Thumbs severed by a roped steer. Forearms gooey from pushing a cow's prolapsed uterus back up into its vagina. And day after day, week after week spent watching a thousand furry creatures chew up a pasture while your own stomach growls. All of this for a wage that works out to about four dollars an hour. What this arrangement guarantees is self-selection. Only those who seek out such misery will endure it.

"Oh, yeah, it was fun," says 18-year-old Tyrel Tucker as he reflects on the winter he spent with his 20-year-old brother, Blaine, tending 2,300 cattle in a camp north of Flagstaff. The brothers slept in a cinder-block shack with cracks in the walls and no electricity. Every day from December until April, they rode on nearly 100,000 acres of land with only the cattle, the horses, and each other for company. Blaine's cooking regimen did not vary: pancakes and sausage for breakfast, a can of sardines for lunch, potatoes and a hamburger on a biscuit or tortilla for dinner. The wind was relentless, and by nightfall the temperatures plummeted to 15 below zero.

None of which mattered. "We got to rope at least one calf every day," says Tyrel. "You get to

Cowboy Country

Time was when the shape of a cattleman's hat showed what part of the West he came from. Distinctive cowboy styles developed to reflect the terrain and local culture. Today, hired hands move from ranch to ranch, mixing customs as they go, but four time-honored traditions endure in separate regions.

VAQUEROS

In the 1600s, as the cattle business of New Spain began in what is now Mexico, herders known as vaqueros donned the iconic saucer-brimmed sombrero for shade. Today they've adopted many customs of the Texas cowpunchers.

BUCKAROOS

With a label derived from the word "vaquero," buckaroos adapted the customs of old Mexico to colder climes and wide open spaces—wooly chaps for warmth, hats with broad, flat brims, 80-foot-long braided leather riatas, and bits, spurs, and saddles sparkling with silver.

COWPUNCHERS

Named after the men who once prodded cattle onto railroad cars, cowpunchers wear hats with brims that curl like tacos and long chaps that shield their legs from thorns. Short ropes allow them to catch their charges amid the thick brush of the Southwest.

COWBOYS

Answering to the term that generally describes all western cattlemen, cowboys of the Great Plains borrow styles from their neighbors—a little silver and a longer rope from the buckaroos, combined with the full-length chaps of the cowpunchers.





Born to be cowboys, H. G. and Cooper Adams (center and right) join Tanner Rollins for chores on the XI Ranch. Their great-great-grandfather bought the Kansas spread, and H. G.'s son, one-year-old Horace Greeley Adams VI, may one day take up its reins.

COWPUNCHER

"I was breaking a young horse, and he reared up and pawed me in the side of the face. When

the vet come out the next day, he put some stitches in and stuck the Band-Aid on. I couldn't see very good for several days." —*R. D. Horn, Adrian, Texas (right)*

be by yourself. Do your own thing, don't get bothered by the boss. I'd go back again."

The Tucker brothers are lanky and taciturn and uninterested in any other life save the one they have led since infancy, when they rode horseback before they were able to walk and received their first horses by the age of two. Not for sport, however: Their mother, Michelle, tended the family ranch near Powell, Wyoming, and needed her boys' help. When Tyrel was 17, he volunteered to drop out in the middle of his sophomore year of high school to get his GED and work full-time on the ranch. "It was great with me," Tyrel recalls. What was there to miss? All of his classmates spent their free time playing Nintendo.

Blaine wears a Fu Manchu mustache, as do his father and his uncle. Tyrel is still working on his. With the hand-to-mouth lifestyle and the desire for independence comes an unexpected though endearing vanity: Cowboys care about how they look. A man who drifts from ranch to ranch, camp to camp, may not ever own a bed, much less a house. What he wears and what he straddles are pretty much all he's got. "You can do this job in tennis shoes and a ball cap, I guess," acknowledges Pat Crisswell, a compact Oklahoman who now tends a camp on the 150,000-acre Wagonhound Land and Livestock Company ranch in Wyoming. "But the more old-timey, the better."

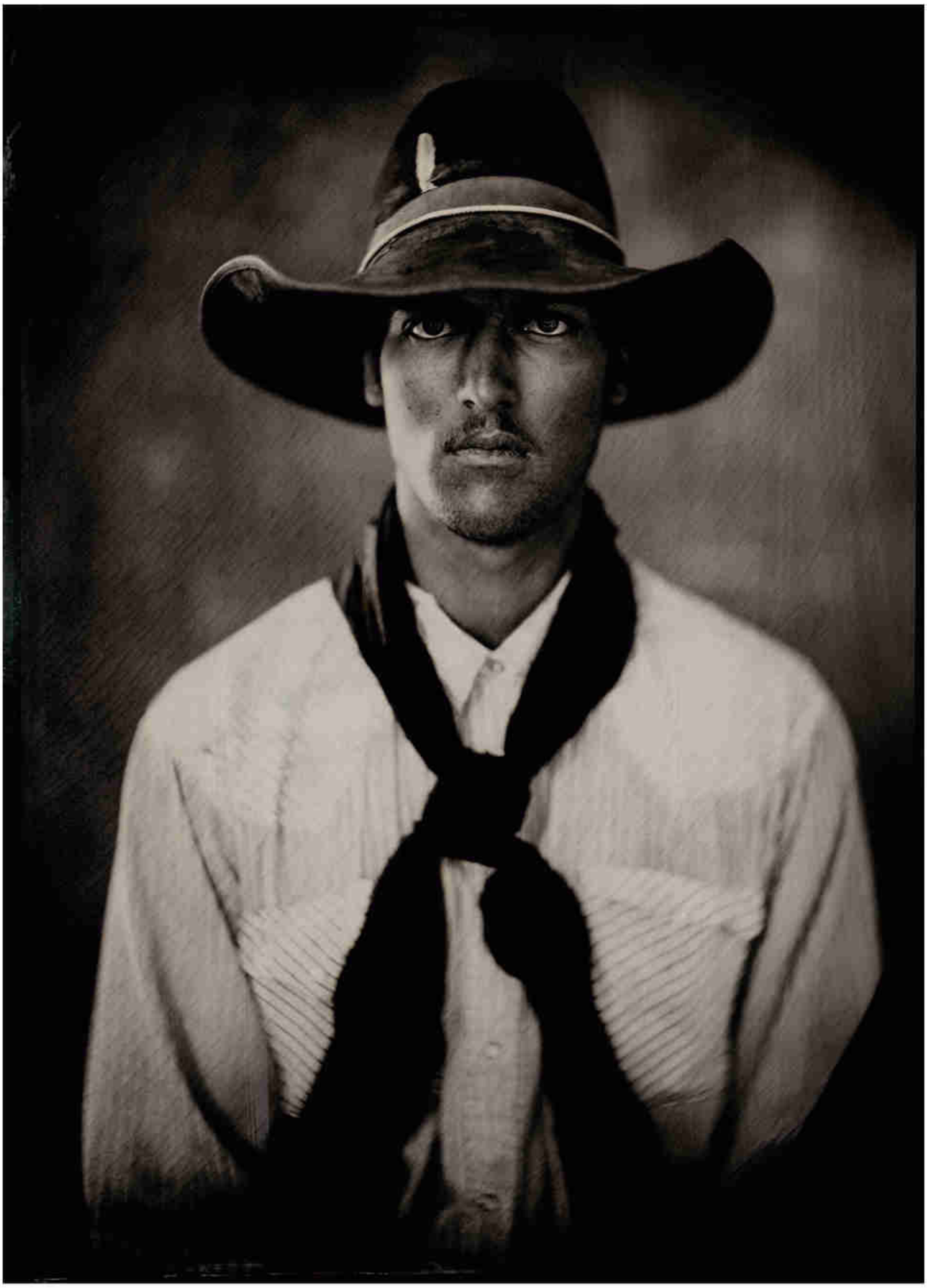
The original vaqueros—derived from *vaca,* Spanish for "cow"—were horsemen from present-day Mexico who drove cattle into Texas and up into California. Replete with engraved silver and embellished leather gear, the vaqueros cut gallant figures on the surly canvas of the Old West. But form was seldom without function. Their flat-brimmed hats and bandannas warded off the sun and the dust. And for durability, no cotton rope could compete against a hand-braided rawhide riata.

The vaquero style lives on in varying degrees in different regions. Mexico, with its sagging economy, is no longer chief custodian. Instead, California and Nevada buckaroos (itself a corruption of vaquero) are most apt to follow the tradition to the letter: half chaps, flashy silver bits, wide, flat-bottomed stirrups, slick-fork saddles, and the compulsory long ropes and flat hats. To the buckaroos, finesse is key. Rather than constantly jabbing, the buckaroo prefers to cue his horse with his spurs. The uncorrupted art of cattle roping—and God strike a cowboy dead for doctoring a sick cow from a four-wheeler instead of with a horse and lasso—involves first catching the cow, then dallying, or wrapping one's rope around the saddle horn rather than tying it on. This takes more time, but the buckaroo does it anyway, without apology.

"I like the slower pace—throw a big, purty loop, not a hurry-up deal where you're cussing at people," says Wes Miner, the Montana native who was reared in the rodeo trade and now cleaves to the buckaroo ways—as do others less devoted. He notes ruefully: "I wore the flat hat for years. Then one day in Bozeman I saw two guys wearing ones like mine. Turned out they worked for a gardening store."

Buckaroos are afforded their style by the wide-open terrain on which they labor. More rough-hewn landscapes breed a correspondingly unfussy approach to a cowboy's work and dress. Brush country tears up jeans, necessitating the full-length but unadorned shotgun-style chaps worn by cowboys (sometimes called cowpunchers) in the Great Plains states and Texas. Brushy, tree-cluttered environs require shorter ropes and swell-fork saddles to tie on to. (Dallying is, well, dallying.) In windy areas, a stiff gale can knock a flat hat off a cowboy's head, so he may prefer the steadier taco hat. Buckaroo purists may disparage the spartan, gritty style of cowpunchers as

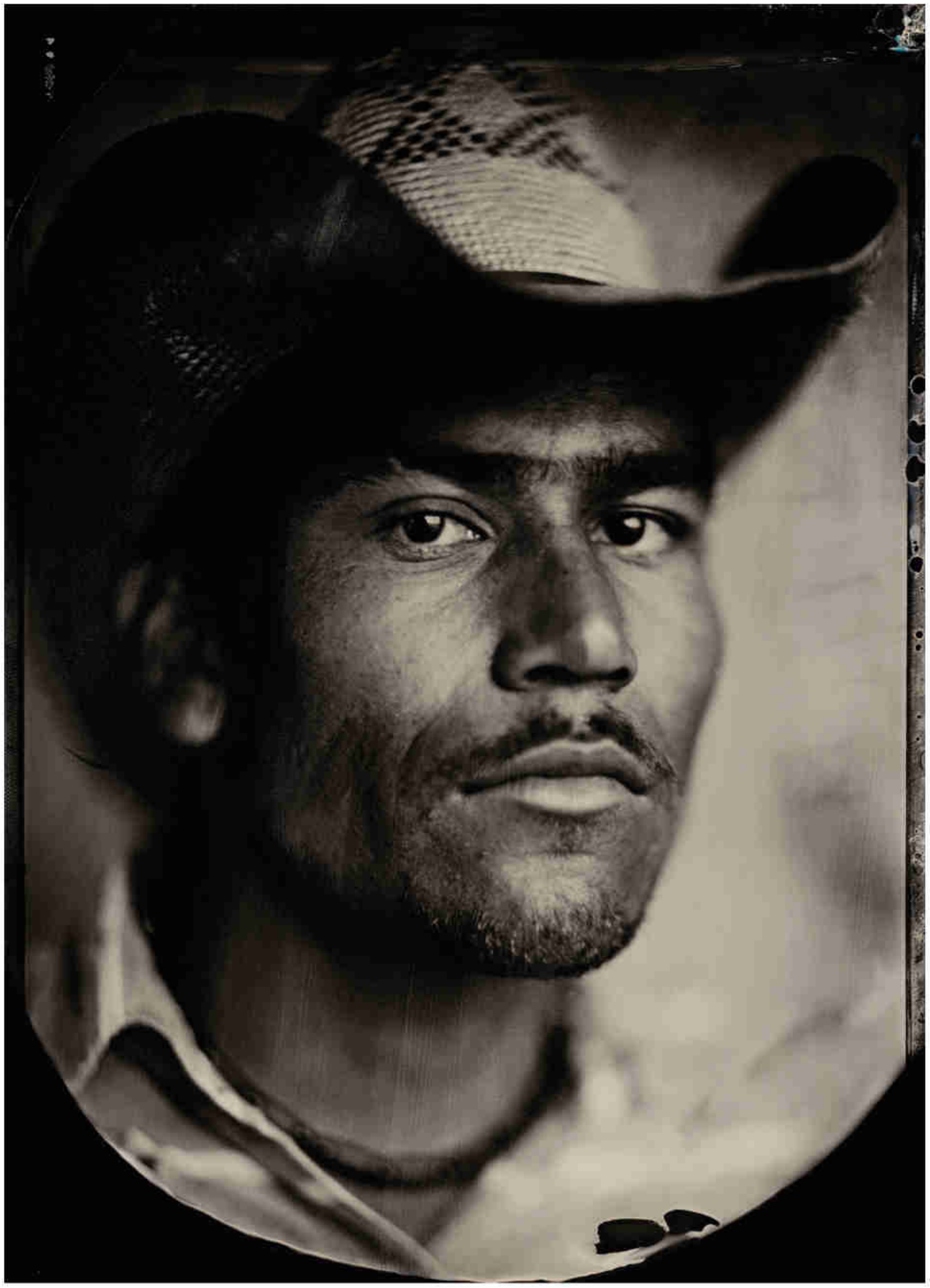




COWBOY

"When you ride a bronc, that's real fun, a good adrenaline rush. I've been bucked off

a bunch, been kicked, been stepped on. I've never had any come sailing through the air and land on top of me, though. I'll probably be cowboying till I kick off, or I'm too old and crippled to do it anymore." —*Tyrel Tucker, Powell, Wyoming*



VAQUERO

"I was four when I started helping my father at La Mora Ranch—the fourth generation

of my family to work there. I got married recently and moved to the city, but as soon as our first child is born, we're going back. The countryside is beautiful, and the air is completely clean." —*Manuel Rodríguez Franco, Coahuila, Mexico*



BUCKAROO

"The draw? Well, it's stuff you can't explain—to ride over the hills when the

sun's coming up and there's 300 elk feeding. Our job is our hobby. It doesn't pay good enough otherwise." ***—Wes Miner, Snowline, Montana (left)***

"hard and fast" and "rammin'-jammin'." (The term cowpuncher probably derives from the brisk manner in which 19th-century ranch hands loaded cattle onto trains.) But looks deceive. The care in a cowpuncher's work is as evident as in the more stylized rendition of the buckaroo's.

Tyrel Tucker did not know much about these loose distinctions among cowboy traditions until his brother, Blaine, returned from summer on a ranch near Pryor, Montana. The buckaroos there wore silver-studded half chaps, reined their steeds with twisted horsehair mecates, and swung long rawhide ropes. So, now, do the Tucker brothers. Tyrel spends his free time working with silver, designing belt buckles and bits and spurs. The way other young men obsess over sports teams or computer games, Tyrel and Blaine Tucker devour every granule of the cowboy culture.

NOT EVERY COWBOY is born into the life. "Some are loved into it," says Pat Crisswell, a racehorse jockey's son. "I had a government security job. The money was great, but I didn't like the city, and I spent more time in bars than I should've. So I went to the Pitchfork Ranch in Guthrie, Texas. Went from $20 an hour to $750 a month. Guys I left behind thought I was crazy. I told 'em, 'There's a little somethin' called job satisfaction.'"

The cowboy culture is more egalitarian than most. You can find boilerplate Westerners riding cattle—but also African Americans, Mexicans, Canadians, and even Mennonites, not to mention emigrants from Germany, Brazil, Australia, and even India. Most who heed the call are young single males stirred by the outdoorsman's yearning for manly adventure. But of course there are cowgirls, too, like Jodi Miner, a clear-eyed woman with a formidable handshake who grew up on a ranch near Dell, Montana, doctoring calves, repairing water tanks, and mending fences. In between college semesters at Bozeman, she took jobs calving and branding heifers and slept in bunkhouses surrounded by snoring men. Today, she and her husband, Wes, run the Snowline Ranch together on behalf of an absentee board of directors. They get free housing for themselves and their two young daughters. In return, the board expects Wes and Jodi Miner to devote themselves to ranch management, dealing with the Bureau of Land Management and the Forest Service. Cowboys have long been gypsy-like in their meanders—ever searching, through word of mouth (cowboys don't Google), for that optimal blend of agreeable terrain, independence, and the opportunity to stay in the saddle. "In Montana, there aren't many straight-up cowboy jobs anymore," sighs Wes Miner. "For the most part, you're gonna have to get off your horse a bit."

So the Miners, and most of their ilk, get off their horses. Adapt they must, when they must. Cowboys have seen the alternative to their life, from a safe distance: men who live for the weekend, for their golf game. There is no Monday or Friday out on the ranch. There is no "hobby." Instead, there is just being on a horse among three hundred elk and watching the sun rise. Cowboys don't rhapsodize about such pleasures. Leave that to the poets or the keen brilliance of artist Charlie Russell. The cowboys hold their passion in reserve—waiting till the snows melt and the cattle trailers pull up to the gates, followed by the year's first swell of hoofbeats. Then the vaqueros fall out of time, and they're riding and hollering, boys for one more season.

Vintage Style Watch photographer Robb Kendrick demonstrate the art of the tintype and view more cowboy images in our Photo Gallery at **ngm.com.**

Men who spend all day on horseback are particular about saddles. “Over the years, you figure out what works best for you,” says Pat Crisswell (right) who uses a Texas-style swell-fork saddle on a Wyoming ranch. Chad Milius favors a buckaroo-style slick-fork rig.

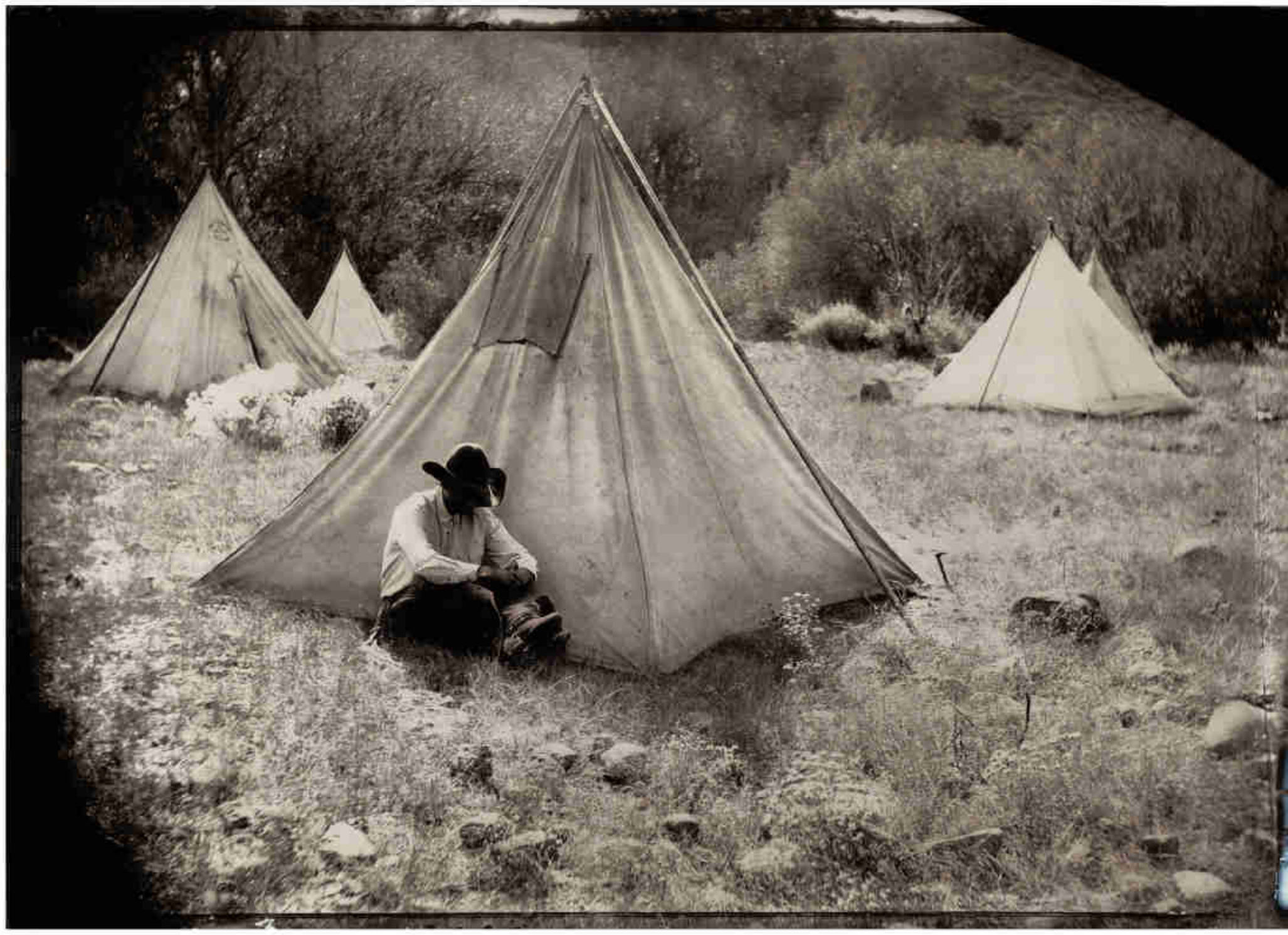




Native American cowgirls Harli and Ashley Cota (left and center) and Jessica Kelly rope and ride on the Duck Valley Indian Reservation in Nevada. Ashley, now 19, is studying ranch management to help her family market their hormone-free beef.

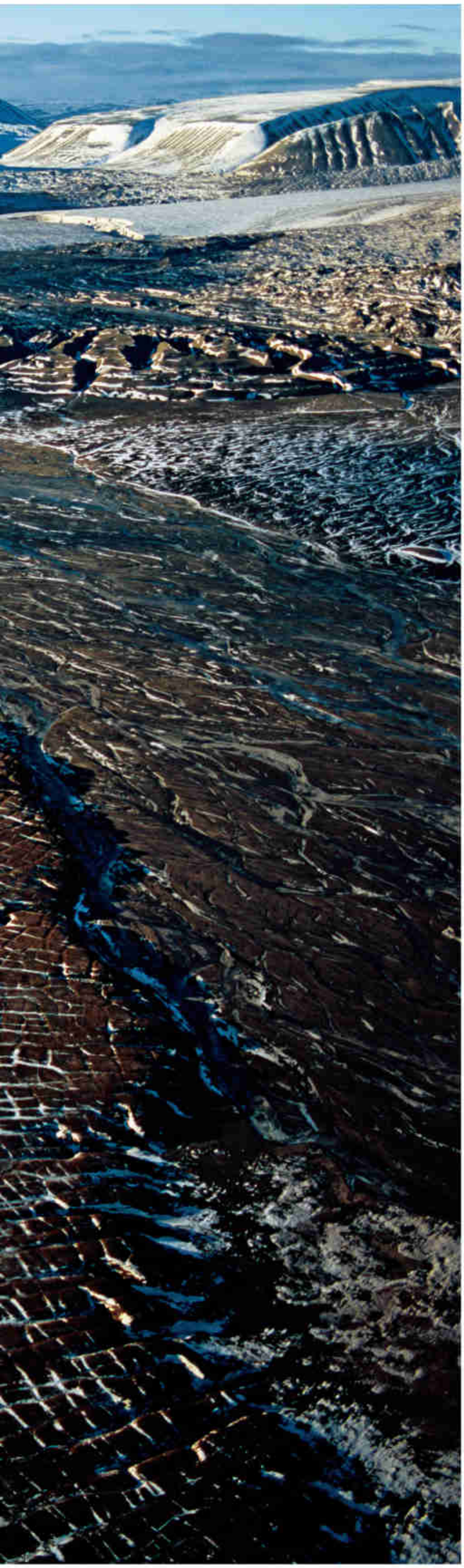






Though tough at times, the cowboy life has its rewards. Mennonites Marcel and Jane Troyer (left) run their own herd when they can lease land near Pueblo, Colorado, and Marcel also takes temporary ranch jobs. They hope to teach their sons the value of an honest day's work and the sense of accomplishment it brings. Linc Bundy (above) moves into a range tepee during roundup at the ORO Ranch in Arizona, far from his wife and three children, but he sees sunrises and sunsets, and he rides through singing grass under the open sky every day—a cattleman's paradise. □





ESSAY BY BARRY LOPEZ
NATIONAL GEOGRAPHIC CONTRIBUTING WRITER

PHOTOGRAPHS BY
BERNHARD EDMAIER

Cold scapes

Otherworldly beautiful, the lands of perpetually frozen earth reveal the delicate rhythms of the planet. But will permafrost stay permanent?

DEEP COLD ETCHES THE SURFACE OF A FROZEN VALLEY ON NORWAY'S SPITSBERGEN ISLAND.

Permafrost terrain encompasses vast reaches of the Northern Hemisphere. In Iceland's central highlands, braids of summer meltwater flow from a nearby glacier and flank a cluster of ragged ponds. Perched on impermeable ground, the shallow pools spread, likely shaped by prevailing winds.





Ice wedges penetrate deep into frozen soil, chiseling tundra into room-size polygons—a signature texture of permafrost landscapes. Climate change may be marking the Canadian Arctic, too, as meltwater erodes the edges of some polygons and deepens pools in their centers.

EARTH'S LUNAR SATELLITE, THE MOON, IS AN ALIEN and remote though still compelling landscape known to us all. We imagine it from our front lawns and our apartment windows as a place of absence. No wind, nor any blade of grass for a breeze to stir. No people. No cascading brook or animal track. But unearthly beautiful all the same. On a clear night, with a pair of ten-power binoculars, the craters and highlands, the depressions and seas, appear so vividly etched, the pattern of their shadow and light so captivating, that the geography can induce a sensation of joy. The beauty of such a moment is hard to explain. It's as if beauty were not actually in the thing itself—the basalt plain, the crater—but lay instead with the viewer's capacity to appreciate that object. When a portion of the moon resolves itself sharply through the binoculars' prisms, when it comes alive to a viewer's eyes, he or she can experience a kind of euphoria, which the moon alone cannot explain. It is, for some, the thrill of being fully alive.

The world is beautiful, in many unfathomable ways. In our hurrying, though, we frequently miss what is beautiful around us, in the same way that we forget from time to time what we want our lives to mean. Just to stay afloat in the modern world, many of us reluctantly choose detachment from the constant stimulus. We even turn away from beauty, as if it were another thing we had had too much of.

Gazing at these images, I think of our habits of detachment. More than any other region of the planet, the Arctic has responded in starkly visible ways to global climate change. It is here, if you will, that a canary is singing faintly in a mine shaft. To make pictures of these places—this is my presumption—I imagine the photographer had to have been thinking about us in some way, about how we are going to fare. The images are not merely beautiful, an exoticness to admire, but an invitation to reattach ourselves to the Earth, specifically to a place that has now grown oddly poignant.

Like the moon, these landscapes appear alien and remote, exquisite but vaguely threatening. We're an integral part of them, however. The pingos and polygons, the rock circles and beaded streams, all are part of us in a way the lunar highlands and seas are not. Or, to be specific again, what's happening on the Mackenzie River Delta in Canada this spring bears more on the fate of our families than whatever might be happening in the lunar valley of Taurus-Littrow during the same weeks.

I don't know whether you have ever had the good fortune, even the desire, to fly close over the Earth's coldscapes or to wander in Svalbard, Iceland, the Canadian Arctic, Siberia, or Alaska—some of the places where permafrost is slowly disintegrating, sea-ice cover thinning and shrinking, where glaciers are retreating. I had that unquenchable desire once, and when I look at these scenes, I feel a longing akin to the longing one sometimes feels for the landscapes of childhood, from that time before the world noticed you and you began to feel its weight in your life. I recall the exuberance with which I used to camp on vast expanses of wet



Barry Lopez is the author of Arctic Dreams, *winner of the National Book Award. The work of photographer Bernhard Edmaier, a geologist and civil engineer by training, merges science and aesthetics. This is his first assignment for the magazine.*



Cold is powerful. It freezes subsurface water, which can force frozen ground upward to form cone-shaped mounds with cores of ice—pingos—on Canada's Tuktoyaktuk Peninsula. Grandest of the more than a thousand pingos is Ibyuk (above), rising 160 feet above the surrounding coastal plain.

tundra, despite the inconvenience of mosquitoes, the difficulty of finding a patch of high ground. Depending on where my companions and I were, tundra grizzly, caribou, or wolves might turn up. I had no aerial perspective, but the view from the ground was equally breathtaking—land rolling outward to all 360° of the horizon, sunlight flickering ceaselessly on a river and on tundra ponds, cotton grass seed heads swaying under the wind, gleaming swatches of red bearberry, punctuated by the green of moss campion and purple blossoms of saxifrage. Overhead, a flock of 7,000 old-squaws or 500 pintails going somewhere fast, and the feathers floating down. Or maybe no birds at all. Maybe the mandible of a fox, suddenly, right where I'd thrown down my ground cloth.

And then there was the next day, when we'd fish once more for char and climb that pingo on the horizon and paddle on and farther on, because it was so unbrokenly beautiful. It was untrammeled; it appeared never to have been occupied. There were no ruins, no fences, no flags, no roads. Nothing had been erected. It spoke to something primordial in us and abiding.

We would come on fresh tracks or scat and then glass the land all around. Where were they? The residency of animals was obvious here, but they were not visible. We paddled on, always trusting, in the days before GPS, we were not lost.

And all the time it was "we." Not for safety alone, or the ordinary benefits of companionship, but to be able to share enthusiasm for a countryside that never had to resolve itself into words to be appreciated. Increasing the intensity of one's private relationship to a place like this worked at the same time to increase the intensity of one's human relationships. For us, the land, utter monotony to some, was so full of eternity it was scary. It hummed with endurance. It radiated completeness. And for a few weeks we were a part of it, the mysterious rock circles, the perfect repetition of polygons, the labyrinths of water bodies so continuously discontinuous they could not be discretely named. We could hardly find the definitive edge of anything.



Warming waters may have formed the embayment expanding across an icy spit of land in the Canadian Arctic. When carbon-rich blocks of thawing permafrost crumble into the water, they decompose and can release potent greenhouse gases such as methane.

I miss those days. I have since passed other days in remote quarters of the Earth—the Tanami Desert in Australia, the Queen Maud Mountains in Antarctica, the upper Boro River in Botswana—but I feel an affection for Arctic landscapes I feel for no other place outside my homescape in western Oregon. I have often wondered whether it was because the brutality of winter in those regions was never far from my thoughts when I was traveling in the brief bounty of sunlight and warm air called "the high-latitude boreal summer." Could it have been the contrast between these two seasons that broke something open in me once, that allowed me to feel tenderness toward a part of the Earth I did not in any way possess?

OVER SEVERAL DECADES OF TRAVEL, I have often met people who were profoundly intimate with the places in which they lived. Usually they were hunters, hunter-gatherers, subsistence farmers, or pastoralists, people who had to know precisely where they were, physically, all the particulars of it, if they were going to keep their preferred way of life

intact. In conversation, I found the fine points they were attuned to fascinating, but more so the pattern of their knowledge, their skill at arranging myriad details in a pattern that could be recognized, remembered, and put to use. It is exhilarating to encounter knowledge this intimate. Most of us in the modern world have nothing to compare with it, except a working knowledge of the infrastructure of our own highly technical civilization. To see and appreciate, to be immersed for a lifetime in patterns that are not of your own making, that is a different order of things.

My guess would be that someone someday will trace the roots of modern human loneliness to a loss of intimacy with place, to our many breaks with the physical Earth. We are not out there much anymore. Even when we are, we are often too quick to take things in. A member of the group who insists on lingering is "holding everyone else up." I think about this kind of detachment from the physical world frequently, because human beings, generally, seem to long for a specific place, a certain geography that gives them a sense of well-being.

When I was traveling regularly in the Arctic, I routinely asked Yupik, Inupiat, and Inuit how they characterized people from the civilization of which I was a part. "Lonely" was a response I heard with discomfiting frequency. The cure for loneliness, I have come to understand, is not more socializing. It's achieving and maintaining close friendships. The trust that characterizes that kind of friendship allows one to be vulnerable, to discuss problems that resist a solution, for example, without having to risk being judged or dismissed. I bring this up because the desire I experience most keenly, when I travel in landscapes like the ones made so evocative here, is for intimacy. I have learned that I will not experience the exhilaration intimacy brings unless I become vulnerable to the place, unless I come to a landscape without judgments, unless I trust that the place is indifferent to me. The practice I strive for when I travel is to meet the land as if it were a person. To encounter it as if it were as deep in its meaning as human personality. I wait for it to speak. And wait. And wait.

THE MOON IS BEAUTIFUL, but I do not live on the moon. The Earth everywhere, even in places where people never or seldom live, is thought to be beautiful, and throughout human history, people of very different persuasions have behaved as if the Earth everywhere were speaking to them. Until now. Now, many more people prefer to believe the Earth is mute, that it has no intrinsic worth. Its worth, they say, lies with its utility. Or with its conventional beauty, its scenery.

It's with thoughts like these that a kind of detachment begins to take hold.

When I look at these photographs, I feel a twinge of misgiving. Disintegration of this frozen habitat is now occurring around the world. A silent warning. We can enter the images here though, even if we have never had the experience of being in the Arctic. The photographs say the Earth is profound and revealing, but in these opening years of the 21st century the nature of the Earth's beauty is changing.

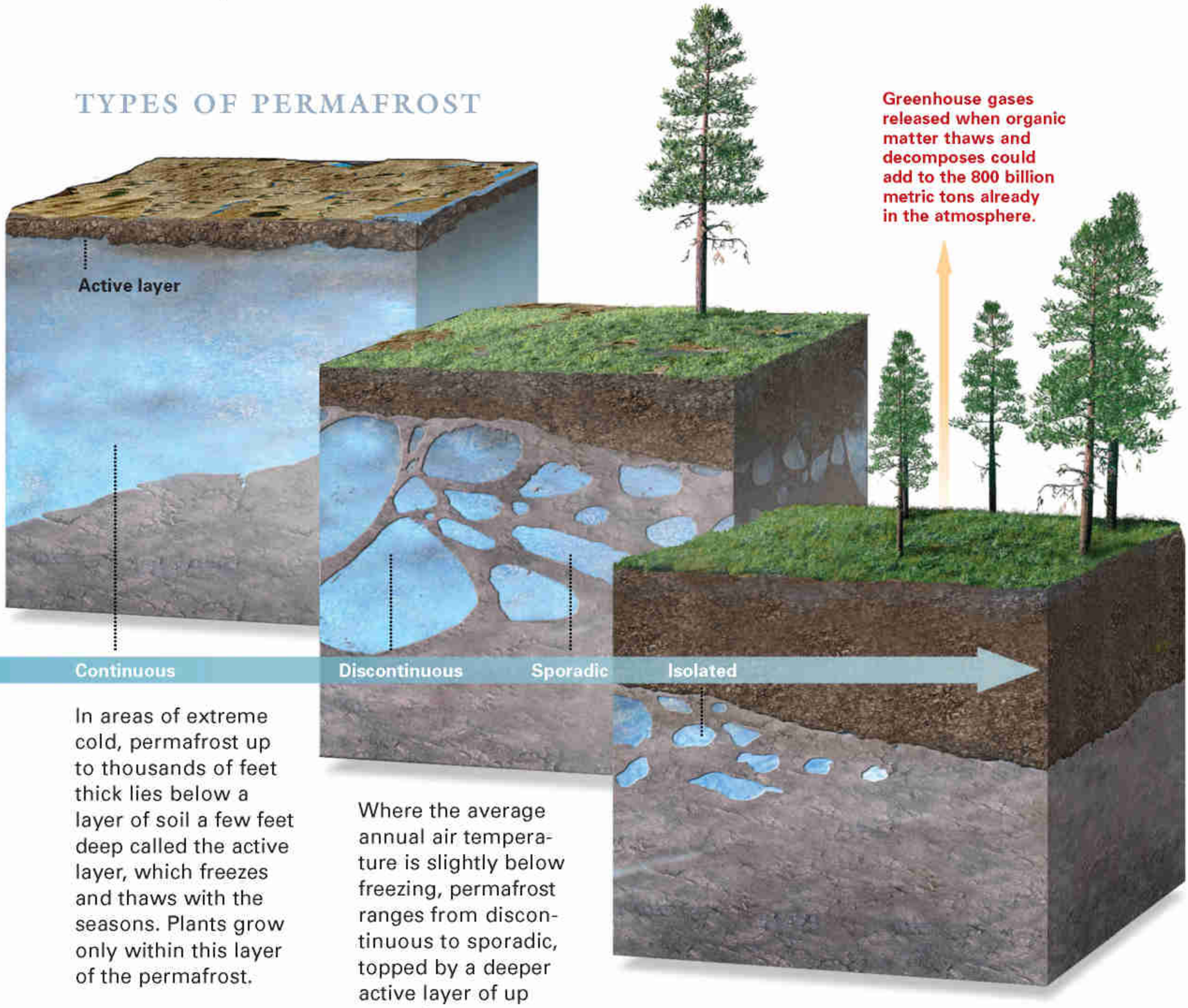
The photographs are asking, What do you think? Years from now, they ask, what will it mean to live in earthly beauty?

Freeze Frames See more aerial photographs of landscapes marked by permafrost at **ngm.com.**

A Threatening Thaw

PERMAFROST IS FROZEN GROUND that remains at or below 0°C (32°F) for two or more years. Most of the world's permafrost has been frozen for millennia, trapping massive amounts of carbon in organic material. As climate change thaws the terrain, the unleashed greenhouse gases could contribute to rising temperatures. But more thawed ground could also spur vegetation growth, which would soak up carbon dioxide.

TYPES OF PERMAFROST



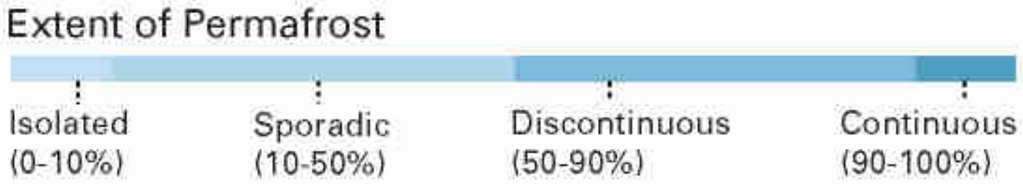
In areas of extreme cold, permafrost up to thousands of feet thick lies below a layer of soil a few feet deep called the active layer, which freezes and thaws with the seasons. Plants grow only within this layer of the permafrost.

Where the average annual air temperature is slightly below freezing, permafrost ranges from discontinuous to sporadic, topped by a deeper active layer of up to ten feet.

Permafrost regions that now experience shorter, milder winters are gaining a thicker, warmer active layer. Carbon stored in organic matter in the upper reaches of permafrost is estimated to range from 500 billion to 1,000 billion metric tons. Warmth increases microbial activity, which speeds the decomposition of organic material and, potentially, the release of carbon dioxide and methane into the atmosphere.

SOURCES: NIKOLAY I. SHIKLOMANOV AND FREDERICK E. NELSON, UNIVERSITY OF DELAWARE; NATIONAL SNOW AND ICE DATA CENTER, UNIVERSITY OF COLORADO; KATEY WALTER, UNIVERSITY OF ALASKA FAIRBANKS; BERNARD HALLET AND RONALD S. SLETTEN, QUATERNARY RESEARCH CENTER, UNIVERSITY OF WASHINGTON; U.S. ARCTIC RESEARCH COMMISSION.
ART BY CHUCK CARTER

Permafrost underlies about 20 percent of the land in the Northern Hemisphere. It is widespread within the Arctic Ocean's continental shelves and in parts of Antarctica. Alpine permafrost occurs at lower latitudes in areas of high elevation. Permafrost regions in Canada, Alaska, northern Siberia, and Scandinavia are facing some of the fastest warming.





SOURCES: NATIONAL SNOW AND ICE DATA CENTER, UNIVERSITY OF COLORADO; PROJECTIONS FROM VLADIMIR ROMANOVSKY, UNIVERSITY OF ALASKA FAIRBANKS. NGM MAPS

Scale varies in this perspective.

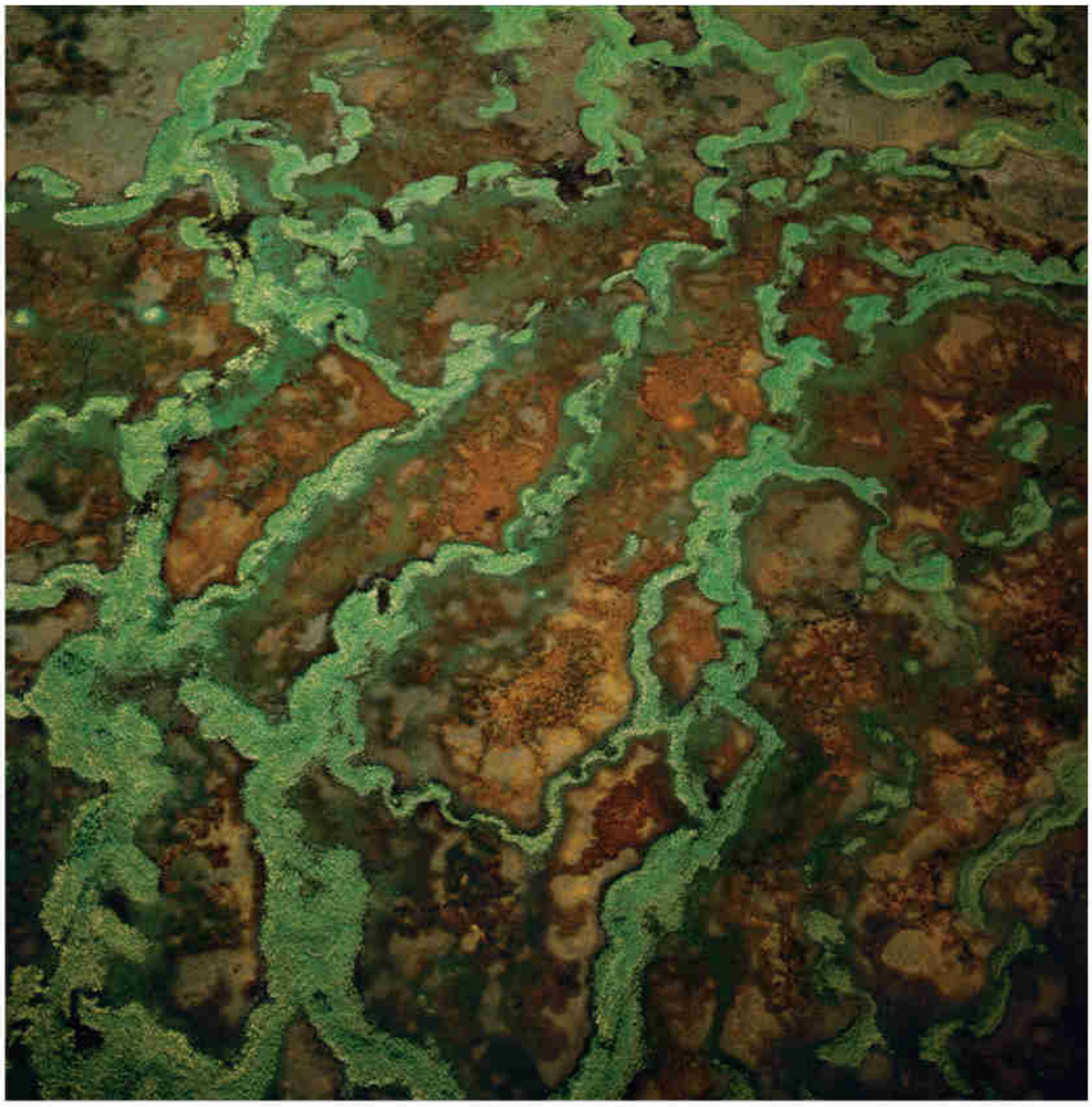




Carrying a crust of mountain debris atop flowing layers of dirty ice, a rock glacier creeps down the face of Sourdough Peak in Alaska's Wrangell–St. Elias National Park and Preserve. Rock glaciers in this area flow up to about six feet a year, overwhelming the trees in their path.



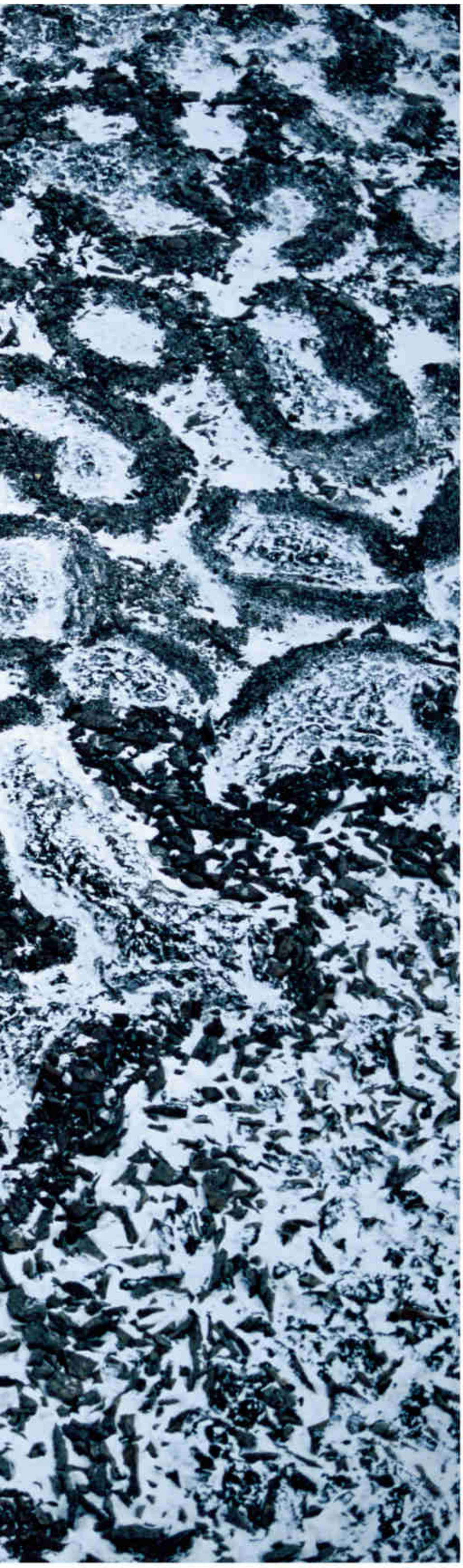
Stretching toward the Beaufort Sea, a liquid silver mosaic of lakes in the Mackenzie River Delta (top) gleam in the constant light of Arctic summer. And in the days before winter seizes the tundra, low-growing plants carpeting Siberia's Vaygach Island (left) flare ocher and gold in the briefest of autumnal displays.



Troughs thick with summer-green sedges and other wet-loving plants ruffle the dry brown ridges of an Alaska bog (top). In Iceland, where volcanic fire does battle with glacial ice, green folds of hummocky terrain and a reddish slash of oxidized soil rise above a black expanse of newer lava.

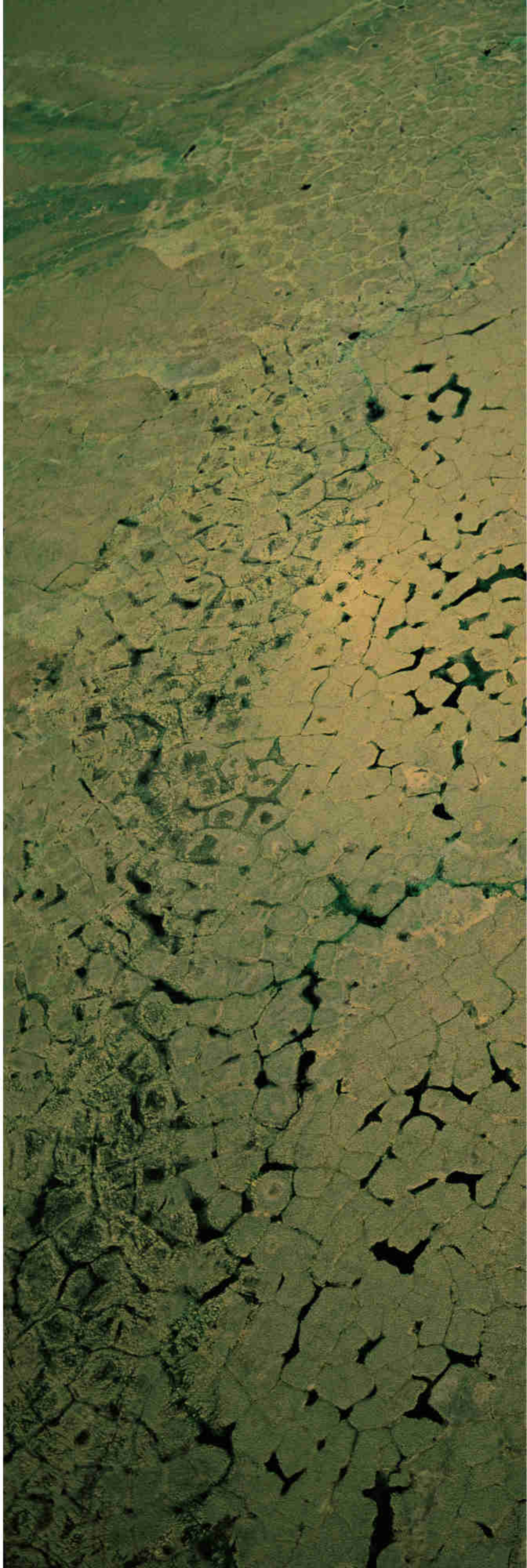






Thawing and refreezing each year, an active layer of soil lies over permafrost. Fine sediments and coarse gravels on the surface shift and tilt as the active layer expands and contracts, sorting themselves over centuries into labyrinths of circles and lines—decoration for an Arctic island.

Darker than surrounding Canadian tundra, ponds absorb more heat from the sun, amplify their own melting, and over time thread together into beaded streams. As the Earth warms, its vast frozen lands are being transformed—and we are only starting to grasp the consequences. □



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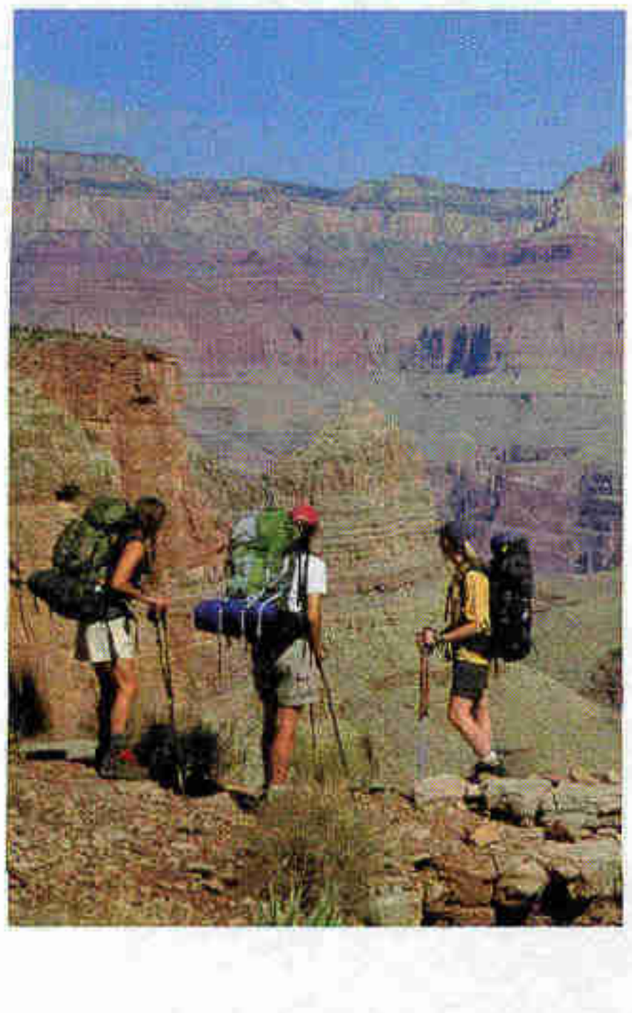
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HOW TO HELP





Mburanumwe (top) was shot, then set on fire by her killers. She was among the first of the slain gorillas discovered by Virunga rangers.

VISIONS OF EARTH, PAGE 18

Stop the Slaughter

After the July 2007 killings of endangered mountain gorillas, possibly by people involved in the illegal charcoal trade, a mobile antipoaching force stayed close to gorillas in Virunga National Park. But the Democratic Republic of the Congo's parks authority, ICCN, must keep the animals safe when these guards are needed elsewhere. Nairobi-based WildlifeDirect—founded by anthropologist Richard Leakey—helps outfit rangers and supplement their government salaries. The group's website *(wildlifedirect.org)* hosts blogs where rangers and others post news and pictures from the field. More groups working together to protect these gorillas include:

- **International Gorilla Conservation Program** This coalition works with the governments of Uganda, the Democratic Republic of the Congo, and Rwanda. *igcp.org*

- **Dian Fossey Gorilla Fund International** Founded by the gorilla researcher murdered in 1985, this organization helps care for young gorillas like one whose mother was killed in July. *gorillafund.org*

- **Zoological Society of London** In addition to helping supplement rangers' salaries, the ZSL works with Congo's park authority to help manage Virunga National Park as a whole. *zsl.org*

- **Frankfurt Zoological Society** FZS has trained and equipped hundreds of rangers; it also provides aircraft to help the ICCN monitor gorillas and direct antipoaching forces from the air. *zgf.de*

PHOTO: BRENT STIRTON, REPORTAGE BY GETTY IMAGES

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INSIDE GEOGRAPHIC



Robb Kendrick loads his camera at Gang Ranch in British Columbia.

ON ASSIGNMENT **Just His Tintype** The faces in his pictures may seem to stare back from some other century, but the men and women Robb Kendrick photographed for this issue's cowboy story were strictly modern-day. Chalk the antique look up to Kendrick's love of tintype photography. Because his camera's iron plates must be developed immediately after they are exposed, he dragged a darkroom trailer behind his pickup truck more than 41,000 miles to round up these images. Kendrick's book *Still: Cowboys at the Start of the Twenty-First Century* will be published in January.



ON ASSIGNMENT **Worlds Away** "In Israel and the West Bank," says photographer Christopher Anderson, "you can drive past a crowded café in Jerusalem, through the wall and into the streets of Bethlehem, and then into this desert (left) in about 15 minutes. It's like passing through three separate universes. People who live within a few hundred yards of each other have no idea how people live on the other side." But they do wonder, he says. "At the checkpoint, Israeli soldiers were often curious about what life was like on the 'inside.'"

PHOTOS: HOLLY WILMETH (TOP); MICHAEL FINKEL

Brazil

become a fan of Brazil's wonders.



Wonderful Rio welcomes the world

There are those who say, with a quirky smile on their lips, that they saw the statue of Christ the Redeemer - for a few short seconds - raise its arms and celebrate its inclusion among the New Seven Wonders of the World. As a matter of fact, the monument still holds its arms open over the city of Rio de Janeiro, and had its new status announced at a ceremony held in Lisbon on 07.07.07. There could not be a more appropriate icon for Brazil, a city so famous for its human warmth and receptivity. And Rio, at 442 years old, is still a place of many parties and constant change. One of the best examples is the City of Samba (Cidade do Samba). Occupying an area of Rio where this rhythm originated, the newest attraction of the city includes numerous samba schools, in a constant state of preparation for Carnival.

Besides all traditional cultural activities and the casualness that marks the lifestyle of the inhabitants of Rio de Janeiro - the cariocas - this year the city had even more reasons to celebrate: Impressive airplane maneuvers at the Air Race World Series, great stars gathered for the environmental cause at Live Earth, and, most of all, the profusion of athletes and tourists for the XV Pan American Games.

To receive all of these guests well, and so frequently, a house needs to have constant care. The result is the improvement of the tourist infrastructure, with more and better hotels, renovated airports, and tourist attractions accessible to everybody, equipped convention centers, enhanced services, and reinforcement in public safety.

Rio always has something new to offer, even to those who already know the city well. And it is increasingly prepared to be the first stop of an unforgettable trip around this world called Brazil.

> Service

How to get there:

There are direct connections between the USA and Rio de Janeiro from Atlanta, Boston, Houston, Miami, New York, and Washington.

When to go there:

It is always the right time to visit Rio de Janeiro. The average temperature is 75.20°F. But the summer (December to March) is the season when Rio reveals its splendor, despite the occasional downpours.

What to take:

Essentially light clothes and swimsuits, slippers, tennis shoes, sunglasses, cap and sun block. A small backpack is also useful. Even at night, few places in Rio require formal clothes. For men, sport pants and a shirt are enough; for women, informal clothes. A light coat is enough for the winter nights.
The electric current is 110 or 120 V and many hotels and buildings have alternative sockets for 220 V.

Tips:

Just like anywhere else in the world, avoid ostentation and the obvious "tourist" look. Gratuities are optional but usually are around 10% of the consumed total and are added to the final value of the bill.



São Paulo: the around-the-clock metropolis

Beautiful, intellectual, democratic, lively, sporting, cultural, romantic, modern, serious, outgoing, professional. Tireless. There aren't enough adjectives to accurately translate what São Paulo - one of the largest cities in the world - represents.
Formed by a mix of nationalities, cultures, faiths and urban tribes, São Paulo has a cosmopolitan soul. Diversity that appears in its architecture, in its tastes and in the clothes of its inhabitants. A city with many cities, São Paulo is an excellent destination for great professional and cultural events with a calendar filled with theater, cinema, contemporary art festivals, as well as exhibitions in tune with the global trends. Among the museums, there are two musts: the Pinacoteca and the Masp, on Paulista Avenue.
A show of its own happens early in the morning at the Municipal Market, where the fresh flavors from all over Brazil are gathered before their trip to the tables of homes and restaurants. Then, in the afternoon, jogging in Ibirapuera Park will help you catch your breath and be prepared for one of the planet's most vibrant nightlife scenes. It is guaranteed fun until the following morning!
This is a place where time doesn't stop. In the early hours of the morning, while some are shopping, others work out in gyms, dance to another song or go to work. To be in São Paulo is to experience an around-the-clock metropolis, with a lifestyle that mixes work and leisure as if they were two faces of the same coin. Surrender to the electrifying adventure of discovering it.



> Service

How to get there:

There are direct connections between the USA and São Paulo from Atlanta, Boston, Chicago, Dallas, Houston, Los Angeles, Miami, New York, San Francisco, and Washington.

When to go there:

Most of the year, the weather is mild. From November to March, the temperature can reach the upper 80's. In these months, it often rains hard at the end of the afternoon, which may make traffic difficult.
In the winter (June and July) it can be very cold, with temperatures dropping as low as 42°F.

What to take:

Professional engagements in São Paulo require more formal clothes. Sport and casual clothes are enough for daytime tourism. The winter calls for something a little warmer. At night, more elegant clothes are recommended. The electric current is 110V in the city, and 220V in many coastal areas.

Tips:

Leave room in your suitcase for purchases! Gratuities are optional but usually are around 10% of the consumed total and are added to the final value of the bill.

Fernando de Noronha

reveals balance between tourism and preservation

Beautiful beaches, crystal-clear waters, soft white sand. The setting may seem like a dream, but it is real and part of life in the Archipelago of Fernando de Noronha (Pernambuco State). Tourism is developed in a sustainable manner here; its 21 islands may only be visited with a permit, which guarantees the preservation of this spectacular ecological sanctuary.
The main island, which has the same name as the archipelago, is the only one that is inhabited and is the largest island of all. Its fauna is characterized mainly by the spinner dolphin and migratory birds. There occurs a rare phenomenon in oceanic islands: the existence of mangroves and swampy plains that meander down to the beaches.
Fernando de Noronha is also a breeding ground for green turtles, which lay their eggs between January and July. Another beautiful spectacle of the island can be seen every day, at dawn, when schools of dolphins swim into the bay, an area of calm protected waters.
Fernando de Noronha's beaches are also excellent for diving, with their high season in October, when the crystal-clear sea waters are calmer and stiller, which makes it easier to find several species of fish, rays, sharks, turtles, morays, barracudas, and dolphins as well as several types of rocky formations, coral reefs, and shipwrecks. Paradise is closer than you could imagine...



> Service

How to get there:

Two airlines have regular flights from Recife (1:20 flight) and Natal (55 minutes). Other options are sea cruises and private ships.

When to go there:

There are two well-defined seasons: a dry one (from September to March) and a rainy one (from April to August), the latter with sporadic rains and intense sunshine. Between August and November the waters are calm and ideal for diving. Between December and March, the sea is rough, good for surfing. The average temperature during the year is 81°F.

What to take:

The climate is tropical and the waters are warm, so take light clothes, caps, sunglasses, sun block, reels, diving mask, sandals or tennis shoes for hiking and walking. The electric current is 220 V.

Tips:

Drink a lot of water and always follow the Laws of the National Park. Camping is forbidden.

Costa do Descobrimento

Discovery Coast: know Brazil since its beginning

The Costa do Descobrimento (Discovery Coast), the southern coast of Bahia State and the place where the ships of the first Portuguese settlers arrived in Brazil, is an area landmarked as one of UNESCO'S World Natural Heritage Sites. It is the destination for an authentic "Brazilian experience", a mix of history, culture, nature, rusticity, comfort and intense fun.

Porto Seguro is the biggest and the most visited city in the region. The Santa Cruz Cabrália area is a great leisure and sport destination with modern infrastructure. Arraial D' Ajuda and Trancoso are also famous for their wonderful scenery. Further south, Espelho beach, located in the middle of a cliff, is always listed among the most beautiful in the country.

To the extreme south, Caraíva is an authentic, well-preserved paradise. And next to it, inside the environmentally protected area of Monte Pascoal National Park, there is the village of Barra Velha, inhabited by the Pataxó Indians, who produce crafts in wood, following their ancient traditions.

In the Costa do Descobrimento, nocturnal entertainment also stands out. Tourists have difficulty deciding if they prefer the daily activities or the nightlife. More than 500 years ago, Brazil was discovered in this area. Why not discover it here yourself?



> Service

How to get there: Porto Seguro is accessible by plane, ship and road BR-367. Distances: Salvador: 449 miles; Eunápolis: 40 miles; São Paulo: 977 miles; Rio de Janeiro: 705 miles; Vitória: 373 miles.

When to go there: The sun shines all year round, but the probability of rain increases in the months of May, July and August. The average temperature is 76°F.

What to take: Swimsuits, trunks, bikinis, light-colored shirts, sandals and sunglasses are the standard uniform of visitors here. The electric current is 220 V.

Tips: Porto Seguro is a traditional Carnival destination, when the city becomes quite crowded. For those looking for partying, it is the ideal. But if you are looking for tranquility, it is better to opt for the coast south of town. Bring a good book!

Foz do Iguaçu: emotion beyond the falls

You are face to face with the magnificence of 275 waterfalls. It is impossible not to be shaken by the force of the waters that gush from 197 feet and get closer and closer to the boat. Adrenaline skyrockets as you enter the 1.87 miles of turbulent rapids of the Iguaçu River on a raft. And there is a lot more to come.

A little further ahead, the currents take you into one of the most beautiful ecological reserves in Brazil and one of the largest in South America. At the Iguaçu National Park there are 185 thousand hectares of rich and exuberant fauna and flora.

From the boat to the ropes. Rappelling is possible from a platform at an altitude of 180 feet, facing the water wall formed by the Iguaçu Waterfalls. But there are other possible adventures in this ecological sanctuary: tree climbing, tyrolese, zip-lining, trekking, mountain biking and rock climbing. It will be difficult to choose one from the 30 climbing routes available to visitors.

After all that adventure, a break to breathe pure air, dive in the fresh waters and recharge the batteries.

And, if you wish, while the sun sets there is still time for some shots on a 717,594 yd^2 golf course at one of the region's resorts. Brazil, Paraná State, Foz do Iguaçu. One of South America's wonders.



> Service

How to get there: By plane, to the Foz do Iguaçu International Airport. There are flights to Foz do Iguaçu from any Brazilian city, most of them with stopovers. From São Paulo, the flight time is approximately 1:40 h. By road there are many options. From Curitiba, access is gained by the BR-277 (Curitiba-Assunción) highway. From São Paulo and Rio de Janeiro, the main access to Paraná is through the BR-116 highway.

When to go there: In the summer the temperature ranges between 72°F and 95°F, and, in the winter, it ranges between 41°F and 72°F. The best time of the year to see the falls is the summer, from December to February, when the rains increase the volume of water.

What to take: Cap, water, sun block. Warmer clothes for visits during the winter, when it is quite cold in the southern part of Brazil. Don't forget to take a backpack. The electric current is 110 V.

Tips: Save room for many pictures in the memory card of your camera.



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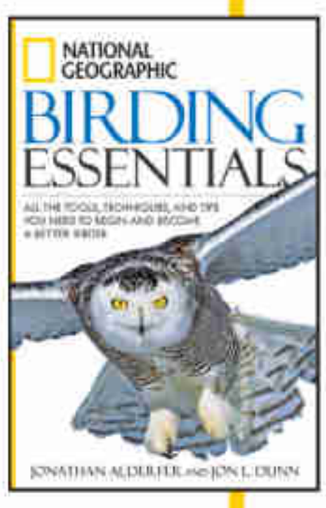
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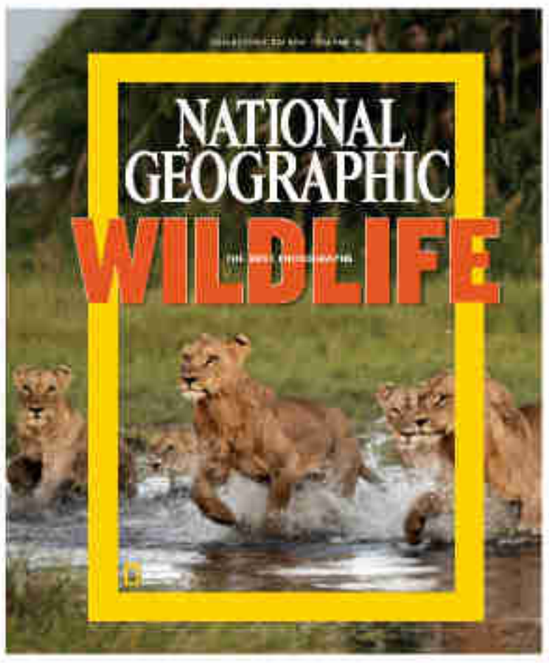
Ira Block bones up on *Deinocheirus* in Santiago, Chile.

Reading List

Birding Essentials Those who take up the hobby of bird-watching in the United States every year join as many as 85 million other Americans with their eyes on the skies. National Geographic's new *Birding Essentials* will help novice and intermediate-level birders improve their skills. Authors Jonathan Alderfer and Jon L. Dunn, both experts in field ornithology, deal with more than just bird identification —though that's covered too. Other topics include equipment needed, range-map reading skills, and tips on building a bird-watcher's library ($15.95).



Wildlife: The Best Photographs A selection of NATIONAL GEOGRAPHIC's finest animal photography is featured in *Wildlife: The Best Photographs*. Beautiful images by the magazine's most skilled natural history photographers make this a collector's item. The book is now for sale online at *wildlife.ngm.com* and on newsstands and in bookstores through January 21 ($9.95).

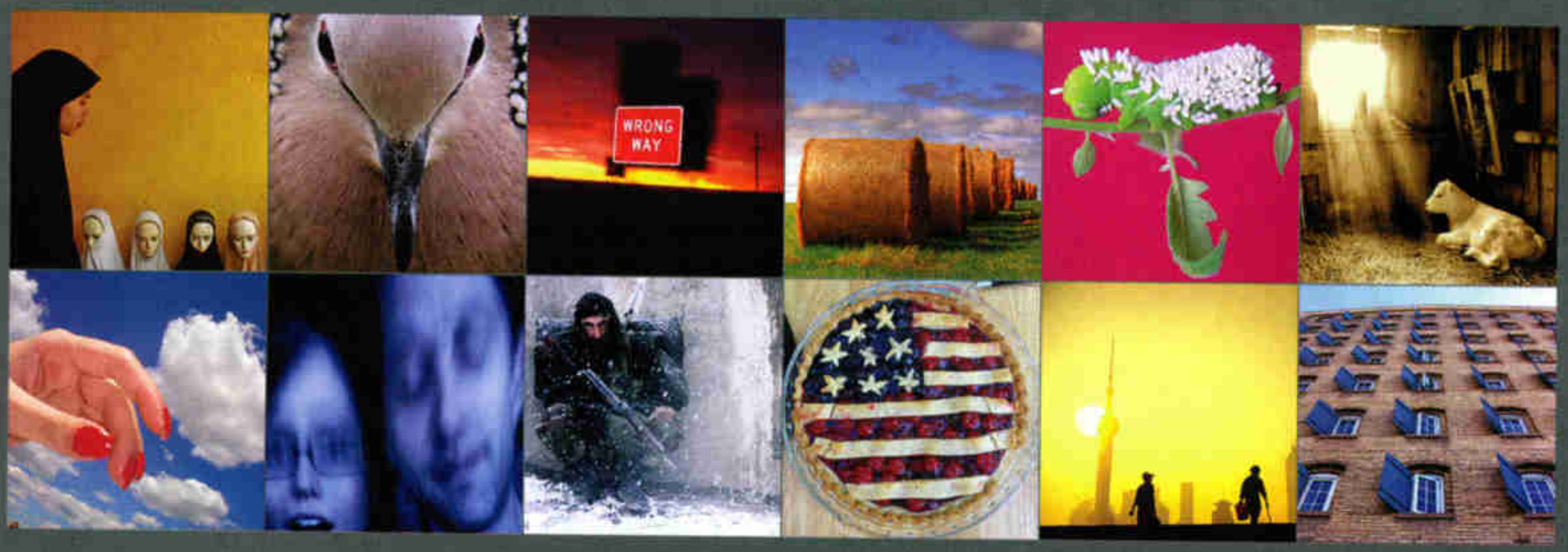


ON ASSIGNMENT **Big Boned** Not much was left of this dinosaur after it lumbered through the late Cretaceous, but photographer Ira Block still had trouble chasing it down. The forelimb (above) of *Deinocheirus*—meaning "terrible hand"—is "from a collection in Mongolia that has been on tour for a few years," explains Block, who specializes in archaeology and paleontology stories. "We first were told it was in Poland, then Italy, and then finally discovered it was en route to Santiago, Chile." He flew out of Beijing to reach San Francisco, then transferred to Dallas to reach Chile in time to shoot the bones before the exhibit opened. But Block finally got what he wanted: a very, very big hand.

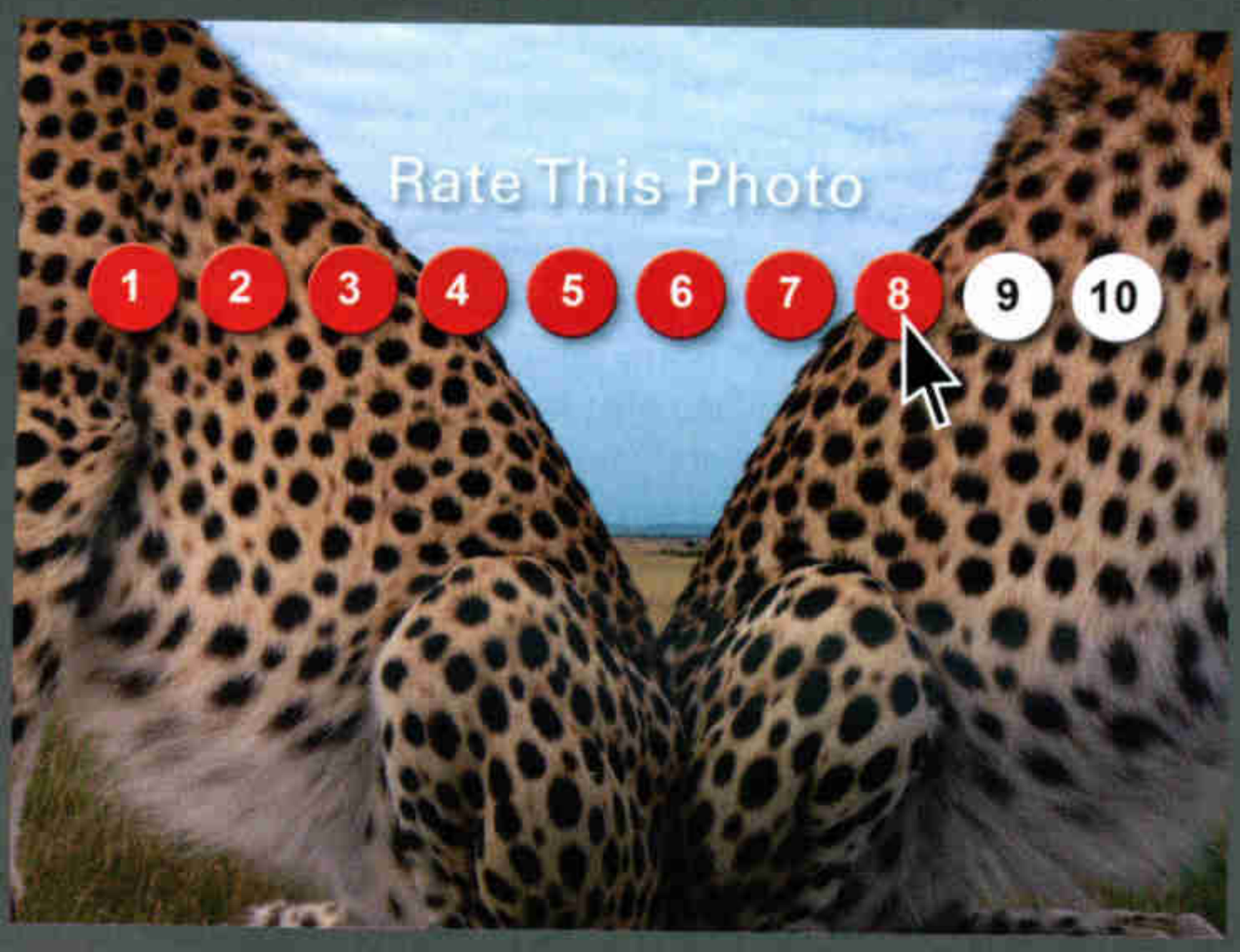
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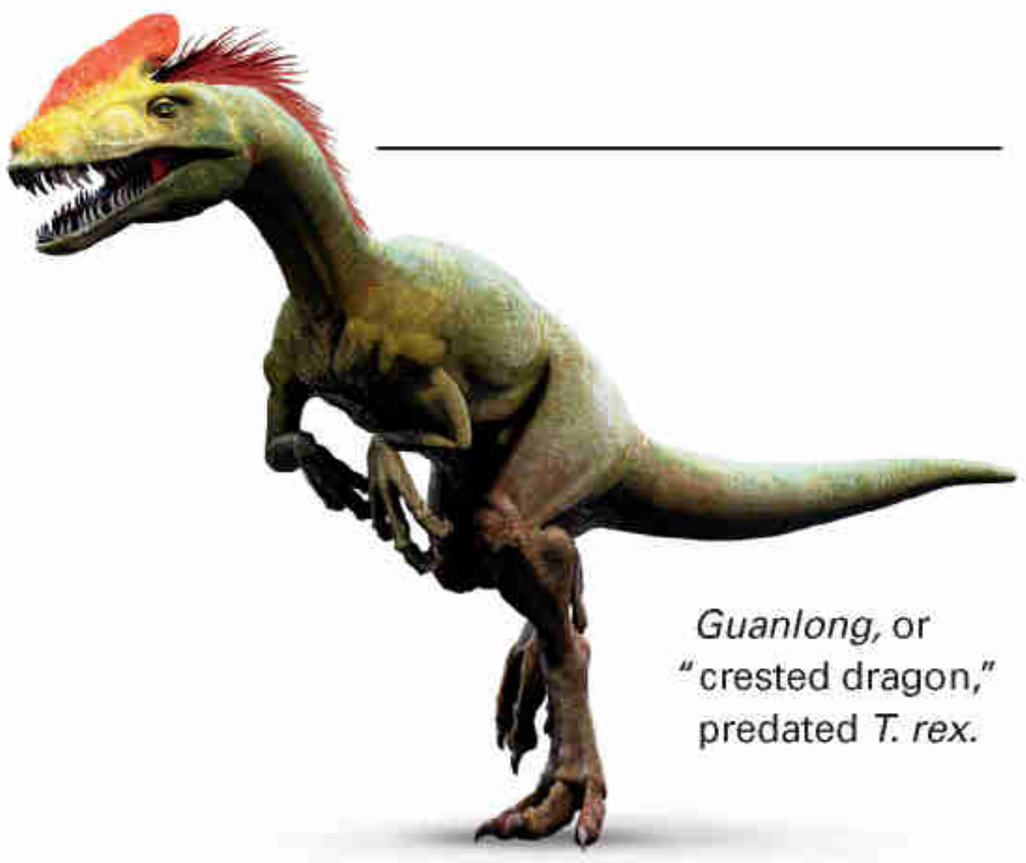


Life has been spinning quickly for John Dau and his family—here on the carousel in New York's Central Park.

UPDATE "Lost Boy" Finds Happiness John Dau's been busy. Since appearing in *God Grew Tired of Us*—the National Geographic documentary on the lives of Sudanese refugees in the U.S.—he's started a foundation *(johndaufoundation.org)* to bring health care and education to the people of southern Sudan. In May, the foundation's first clinic (the first ever in Duk County, where Dau was born) opened; more are planned. "Sometimes I feel like I am dreaming," he says. This year Dau also married his wife, Martha, a "Lost Girl" herself, in an American ceremony. They'd already had an African wedding. Their daughter, Agot, has something neither parent ever had: a birthday. "All lost boys and girls were given January 1 to use as a date of birth," says Dau. "Agot has her very own day."

NATIONAL GEOGRAPHIC CHANNEL

Dino Days Dinosaurs roam the Earth—or at least National Geographic Channel—this month. Watch *Dino Autopsy* to see how 3-D CT scans of a fossilized juvenile duck-billed *Edmontosaurus* let paleontologists examine the 25-foot-long creature in nearly real life. Another Channel offering, *Dino Death Trap,* details China's Gobi desert "Dino Pompeii," where dinosaurs including ceratosaurs and *Guanlong,* an early member of the family that includes *T. rex,* met untimely ends.



Guanlong, or "crested dragon," predated *T. rex.*

PHOTO: IRA BLOCK. ART: 422 SOUTH



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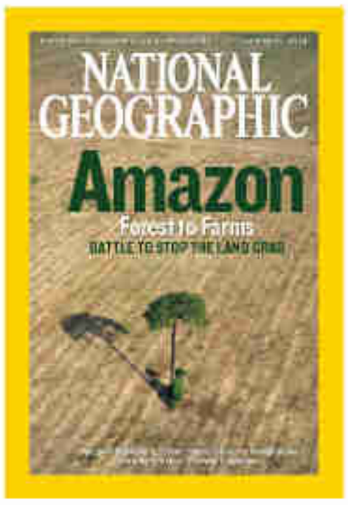


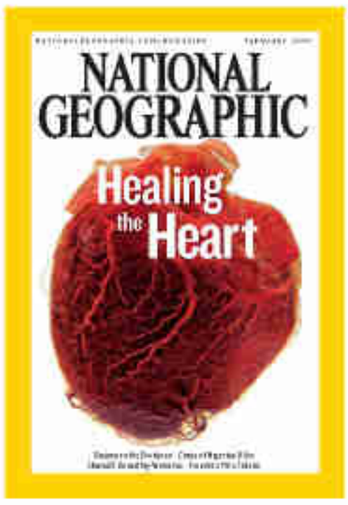
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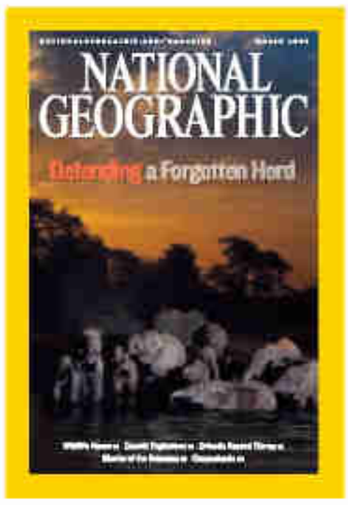
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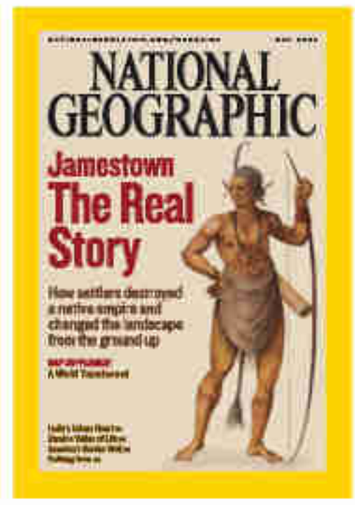
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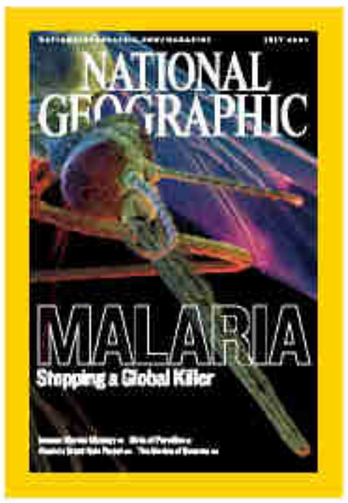


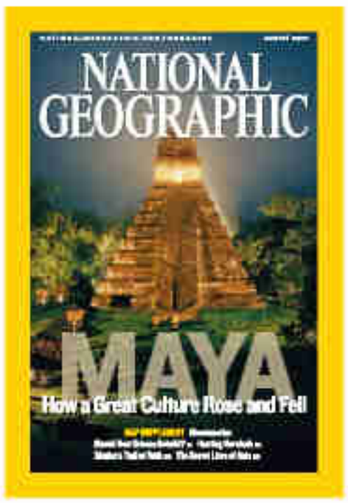


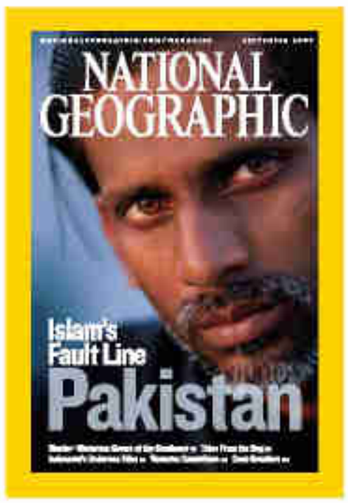


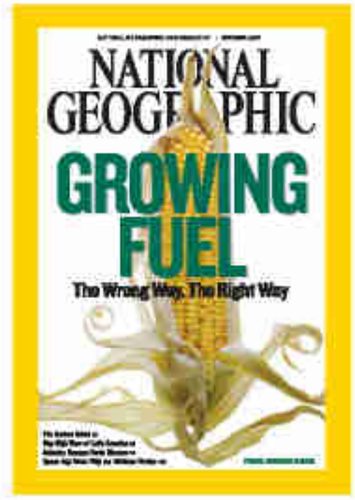


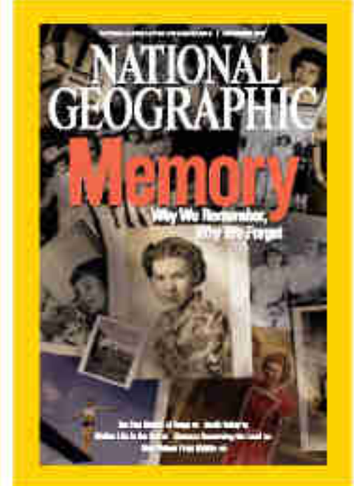














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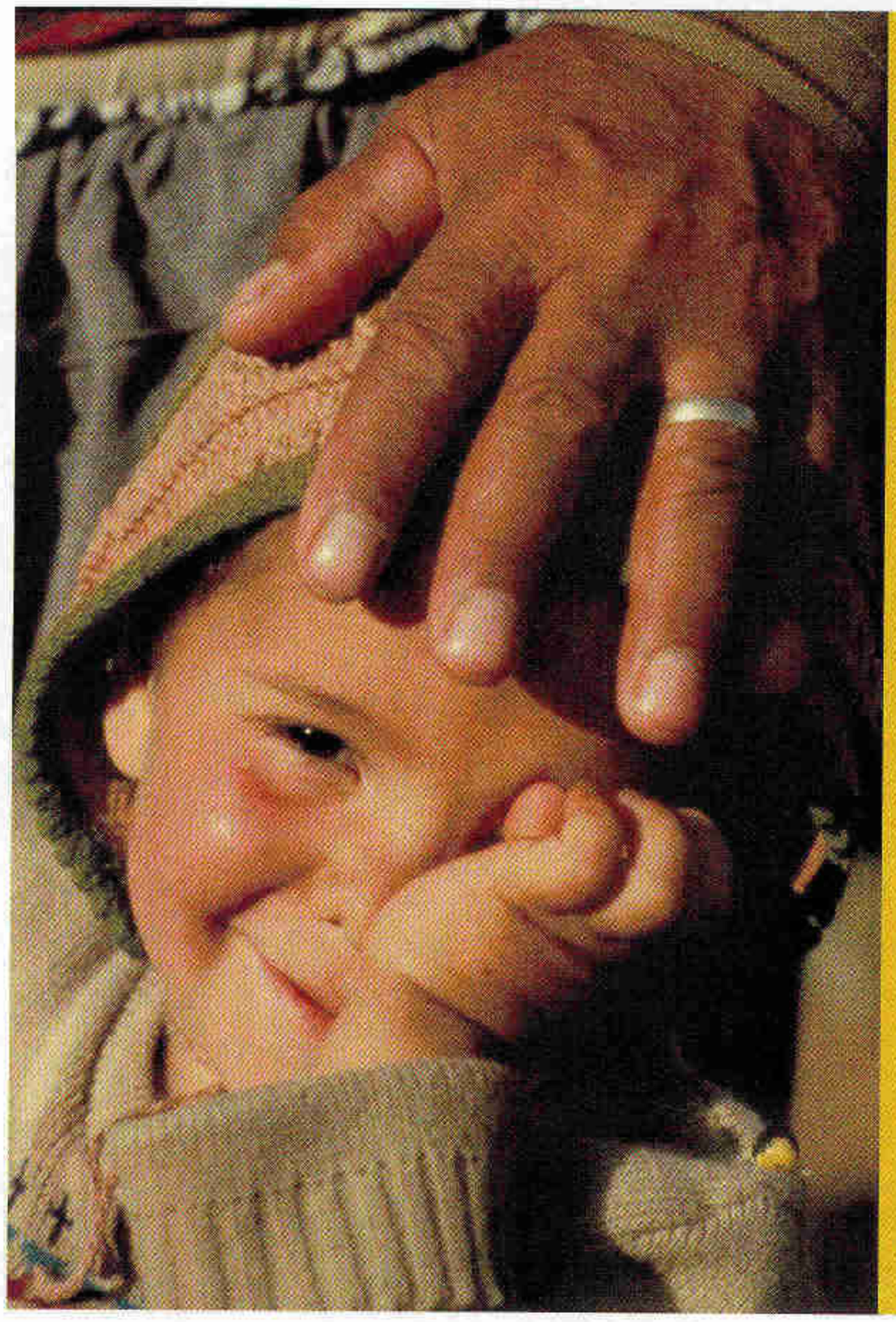
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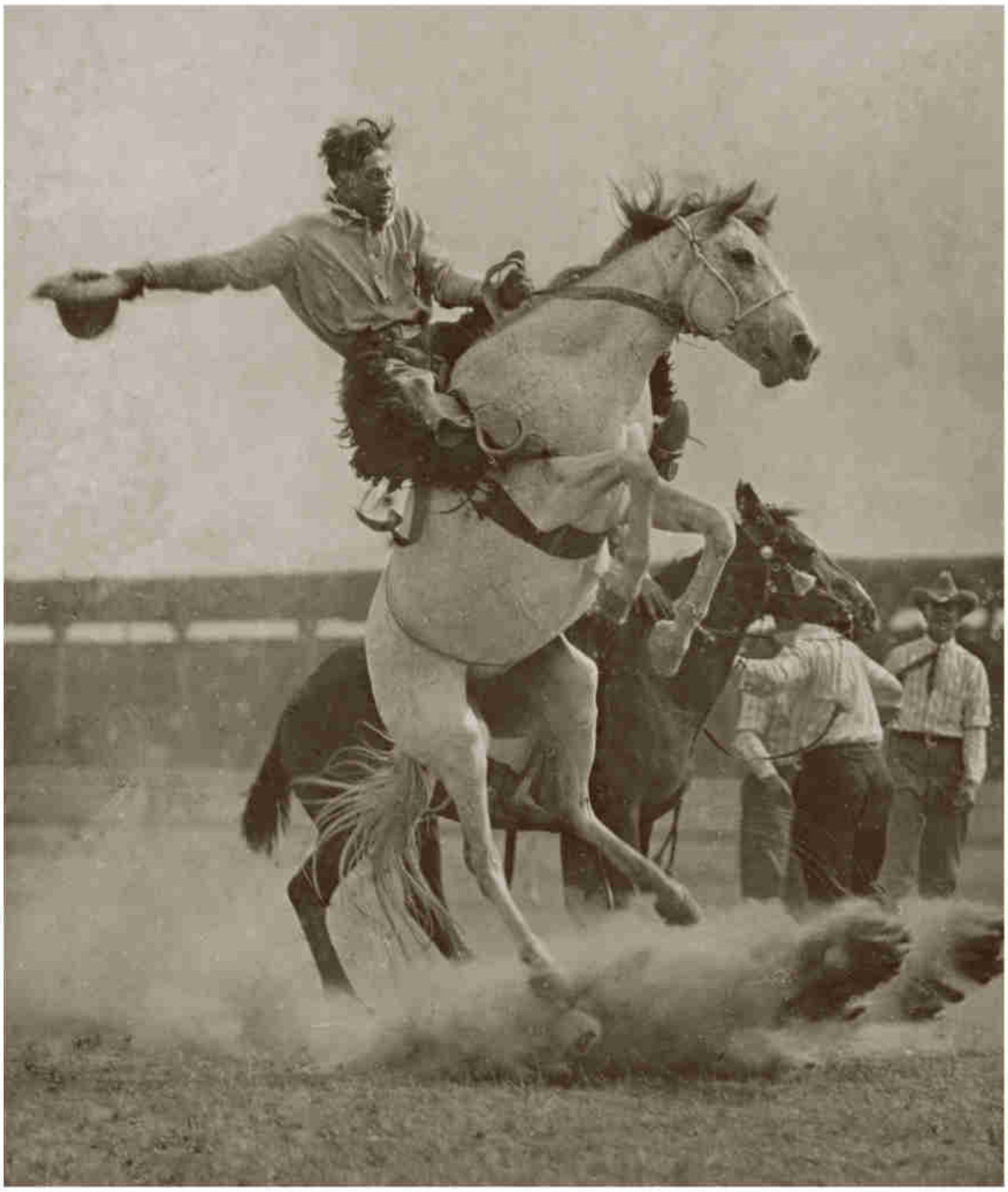
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FLASHBACK



The Buckaroo Stops Here Photographer Ralph R. Doubleday made a career of catching cowboys in midair. From around 1910 to 1952, he followed rodeos big and small all over the U.S., with only a camera between him and the hooves. Doubleday shot rider Tex Parker (above) in 1919 at Wyoming's Cheyenne Frontier Days rodeo. The image never ran in the GEOGRAPHIC, but it was a popular postcard; over the years, "Old Dub" sold millions of his rodeo photos this way. "He would take pictures one day, develop and print them at night, and have them for sale in the stands the next day," wrote rodeo announcer Foghorn Clancy of Doubleday. "His photography has been a big factor in the development of the sport, for action pictures, like nothing else, can depict the thrill and excitement of the game." *—Margaret G. Zackowitz*

Flashback Archive Find all the photos at **ngm.com**.

PHOTO: COURTESY CHEYENNE CHAMBER OF COMMERCE

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